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VIEWS, NEWS AND INTERVIEWS

Some great stories of the freaks of lightning are coming from Maine. Here are samples: Charles Curtis, of Springfield, assisted by a small dog, was driving his cows home from pasture when an angry bolt lighted on a tree above his head, stunning him until long past milking time. When he recovered he found that three of his five cows had been killed and the dog converted into a shapeless mass of cinders. The metal collar about the dog's neck had been melted, and lay in the dust in the form of beads and buttons. The next day Mr. Curtis was able to go out and buy cows to fill the vacancies which lightning had made in his herd. Three men were piling hemlock bark in the woods back of Amherst when the shower struck with fury. Two of them wanted to run to camp, one-half a mile away. Fred Archer piled some bark slantwise against an overturned tree, and persuaded his companions to crowd in out of the wet. While they were smoking their pipes in safety lightning broke into the empty camp and scattered the log walls over an acre lot, throwing the camp stove into a gully 10 rods away. In Dedham lightning struck a pine stub containing a swarm of bees. The honey beds melted and ran down to the ground, leaving the empty combs intact. Every bee was killed.

We are informed by *The Practical Engineer* that: "The purification of acetylene is effected in Dr. Ullmann's process by means of an acidified solution of chronic acid." Just what an acidified solution of acid is, and wherein chronic acid differs from acute acid is not stated.

It is stated, on the authority of an Italian technical journal, that the Pope has ordered from a Parisian maker an electromobile for his personal use. The venerable prelate is particularly fond of carriage exercise, now that his great age renders walking difficult, and it is greatly to be hoped that he will enjoy the new experience. But what an anachronism it will be to see His Holiness, representing all that is old and orthodox, riding in the latest product of this *fin-de-siecle* time.

The United States Navy Department has awarded medals of honor to enlisted men on the "Marblehead" and "Nashville," for coolness and gallantry while those vessels were engaged in cutting the cables from Cienfuegos, Cuba, May 11, 1898.

Superintendent Frank McCoy, of the Monongahela, Pa., Street Railway Company, has completed an arrangement with the librarian of the Carnegie Free Library at Homestead, for opening a branch library at the Duquesne junction of the West End Bridge, Braddock. The books will be for the use of the street-car employés who await orders at the junction, and any book called for which is not at the branch will be procured from Homestead within half an hour.

A new adaptation of electricity for the purpose of stopping bleeding has been devised by enclosing a platinum wire in a pair of forceps or other instrument, the wire being insulated in a bed of burnt pipe-clay. As soon as the bleeding vessel is seized by the forceps and compressed in the ordinary way an electric current is turned on, whose effect is so great that the tissues and the walls of the blood vessels are all agglutinated, so that the blood is no longer able to pass.

Citizens of Philadelphia and visitors during the peace jubilee last October recall with pleasure the beautiful effect produced by the illumination of the City Hall. The committee of councils, co-operating with the Grand Army of the Republic in the preparation for the national encampment in September, has well in hand a plan for illuminating the City Hall on that occasion, on lines more novel and elaborate than ever before attempted.

Galveston, Tex., occasionally talks by telephone with New Orleans, via Memphis, Tenn., 1,121 miles. A direct New Orleans–Galveston circuit, via the Southern Pacific route, is nearly completed, reducing the distance to 351 miles.

Prof. W. C. Roentgen, of Würzburg, has received a call to the University of Munich.

FIG. 1.—ELECTROMOBILE PHAETON, JENATZY TYPE.

THE ELECTROMOBILE EXHIBITION OF THE AUTOMOBILE CLUB DE FRANCE.

A DETAILED DESCRIPTION OF THE PROMINENT TYPES OF FRENCH ELECTROMOBILES LATELY EXHIBITED IN PARIS.

The second annual exposition of automobiles, which has recently been held in Paris, has been a decided success, and the number and importance of the exhibits show the increasing interest taken in this branch of industry in France. This exposition, like that of last year, was organized by the Automobile Club of France. This club, which is composed of prominent manufacturers, inventors and owners of vehicles, has had a considerable influence upon the automobile industry in France, and has rendered an important service in organizing expositions of this kind, as well as competitive tests of automobiles, accumulators, etc.

The exposition of this year was held in two large tents erected for the purpose in the Gardens of the Tuileries, this being a favorable location in the central part of the city. Besides the great number of automobiles and tricycles of all kinds to be found here, the electromobiles were well represented by 25 exhibitors, having a total of 75 vehicles of different kinds.

The Compagnie Internationale des Transports Automobiles, which controls the system of M. Jenatzy, had on exhibition a number of coupés, cabs, dog-carts, etc. The phaeton shown in Fig. 1 is one of the representative types of this firm. This phaeton took the first prize for general appearance at the competitive tests held at Monte Carlo. The delivery wagon of the type now used by the stores of the Louvre was on view, as well as the curious torpedo-shaped vehicle designed by M. Jenatzy (described in the ELECTRICAL REVIEW of July 19), in which he covered a kilometre in 33 seconds, this being the greatest speed yet attained by an electromobile. In general, the inventor uses a single motor, driving the rear wheel by means of differen-

tial gearing, but in some of the more recent types he has replaced this arrangement by two motors which operate each of the rear wheels independently. The motors are series-wound and have two field-coils which may be connected in series or parallel. The accumulators are placed partly under the driver's seat and partly in the rear of the vehicle; 44 cells are used, in two sets of 22 each. To obtain the different speeds the following combinations are used: 1. Batteries, in series or multiple. 2. Armatures of the two motors, in series or multiple. 3. Fields, in series or multiple. These combinations are made by a set of levers, besides which a rheostat is used, which has 10 different positions, including forward motion, with or without resistance; stop; different positions of front and rear electric brakes, with resistance or on short-circuit; reversal of motor, with or without resistance. M. Jenatzy is one of the pioneers in the construction of electromobiles, and his electric cab was the first to circulate in Paris.

The Jeantaud Company, one of the established firms, had a good showing this year. Besides several coupés, phaetons and vehicles of the usual type, M. Jeantaud has constructed the cab shown in Fig. 2, which has made an excellent showing in the competitive tests of electromobiles. The motor operates the rear axle by means of differential gearing and the chain, which will be seen in the figure. The accumulators, which are of the Fulmen type, are placed partly in the rear and partly in a special case shown in the front of the cab. M. Jeantaud also showed the electromobile which was one of the competitors in the races from Paris to Bordeaux in 1895.

The controller is arranged to give speeds of 4, 8, 12, 16 kilometres per hour, as well as a reversal of the motor at four kilometres. At each of these points a pedal, acting upon a resistance, permits a variation of current to avoid abrupt changes of speed. By the same pedal the current is cut off and the electric brake applied; this latter may be given a progressive action up to a short-circuit.

The Compagnie Française des Voitures Electromobiles has constructed several different types of vehicles, among which are the cabs now in use in the city service. In these cabs the motors are placed on the rear axle; the controller is under the driver's seat, and is worked by a lever, which is pushed forward to give the different speeds, and drawn back to reverse the motor and apply the electric brake. The different positions of the controller give four speeds, of 3, 6, 14 and 17 kilometres per hour. The accumulators consist of 44 cells, weighing 750 kilogrammes; their capacity is 135 ampere hours. The consumption of the motor varies from 20 to 60 amperes, and thus the battery provides for a distance of 50–60 kilometres. This battery contains two distinct types of plates, the positives being of the Planté type and the negatives obtained by the reduction of lead chloride. These cells are carried in a large flat case, which is suspended underneath the cab by means of four chains supported by coiled springs fixed to the truck. The case is also held in place by side straps, which prevent it from swinging back and forth. The vehicle is guided by turning the front pair of wheels, the forward truck carrying a bronze crown-wheel, which rests upon a toothed crown-wheel on the axle. These wheels roll one upon the other by means of horizontal and vertical rollers. The toothed wheel engages with a pinion keyed to the vertical steering-shaft, which is held by a column of cast-iron, and carries on top a toothed wheel worked by an endless screw. The conductor turns this screw by means of a vertical hand-wheel, thus giving to the wheels of the vehicle the necessary inclination. This arrangement has the advantage of being non-reversible, but, on the other hand, a considerable number of turns must be given to the hand-wheel. The cab is provided with an electric brake and two mechanical brakes. These latter are worked by a pedal, which first operates a cam for cutting out the current. The same company also showed a series of coupés, phaetons, etc., of a new type, having the motor on the front axle, which it drives by a bevel-gearing engaging with the crown of the differential. The motor, whose armature has a double winding, is the same as that used in the cabs, and the controller is also of about the same construction. The accumulators are lighter, and are distributed in two boxes.

The Krieger Company exhibited a number of different vehicles, including a delivery wagon, which is one of a series used by the large stores of the Bon Marché. In the construction employed by M. Krieger, the motors are attached directly to each of the front wheels, which turn independently of each other. The front axle is replaced by a horizontal bar, carrying at each end a vertical pivot, upon which the motor and wheel are arranged to turn together. The wheel is carried on a short axle, having at its inner end a vertical shaft which fits into the vertical socket carried at the end of the main horizontal bar, thus permitting the movement of each wheel around this central point. A double set of ball-bearings is used in the socket, so as to permit of an easy movement of the wheel. The motor, which is flat and of octagonal shape, carries below a lug in the form of a ring, which fits on the axle and permits its being placed upright directly against the inside of the wheel; its pinion, which is thus about midway between the axle and the tire of the wheel, engages with a large gear-wheel fixed against the inner side of the wheel, thus driving it directly and doing away with the use of differential gearing. The motor is of the four-pole type, with drum armature; the coils are lathe-wound and placed in slots. The armature is supported from the inner side by a single bearing, passing through its interior and about which it turns by means of ball-bearings. M. Krieger has lately designed a light vehicle, in which the motors are placed in a similar manner, except that they are horizontal, the outer end being supported by a curved spring. The accumulators of all these vehicles are of the Fulmen type, and in most cases are placed partly under the driver's seat and partly in the rear of the vehicle.

One of the novelties of this year is the autocab. The conductor's seat is in the rear and above the body of the cab, and the entrance is in front. The inner seat is semi-circular and provides for four persons. The body of the vehicle is supported in front by springs, and in the back rests directly upon the axle. The motor is articulated around the rear axle, and its outer end is supported by a spring upon which it rests by means of a roller; it is of the series type, with two poles, having two superposed field windings and two commutators. Differential gearing is used, and is so arranged as to be entirely covered. The cab contains 44 cells of battery, weighing 350 kilogrammes. These are placed in four boxes under the seats, to the right and left. The controller is a wood cylinder, carrying the usual copper pieces, and is mounted on a tube which turns about a second fixed tube, in whose interior passes the steering-shaft. This controller has 12 points; four of these correspond to speeds of 4½, 9, 14 and 20 kilometres per hour. The electric brakes have six points corresponding to different resistances. The last two points are for reversing the motor and for stopping. The levers of the mechanical brakes are arranged so that by pressing more strongly upon them the electric brakes are also put in action with increasing effect. When one of these brake-levers is used the cylinder of the controller is brought to the zero point automatically, and the motor circuit is thus interrupted. This arrangement has an advantage over the ordinary form of pedal brake which cuts out the circuit, as will be remarked in the case when the vehicle has been stopped at full speed, by pressing down the brake-lever and the driver forgotten to turn the controller to zero; for when the pedal is lifted, the vehicle starts at full speed, which is injurious to the mechanism. The accumulators of this cab are permanently connected in series. With the exception of the starting and reversing points, no exterior resistance is used, the other combinations being made by means of the different windings of the motor. The weight of the cab, with its accumulators, is 1,200 kilogrammes (2,640 pounds), including 4 persons and conductor; the battery weighs about 350 kilogrammes.

The firm of Georges Richard had an interesting exhibit of light vehicles for two persons. The conductor sits on the left-hand side and turns the steering-wheel with the right hand, working the controller with the left; he has under his right foot a pedal which operates a brake on the differential, and at the same time cuts out the current. The circuit may also be broken by a pedal under the left foot. Two hand brakes are also provided. The motor is of the two-pole, drum armature type, taking 2,000 watts normally and 4,000 at a maximum; its weight, including gearing, is about 100 kilogrammes. Three different speeds are arranged for in the controller, 5, 12 and 20 kilometres per hour; and upon reversal five kilometres per hour. The total weight of which is 600 kilogrammes, of which 300 kilogrammes are represented by the battery, which has 44 cells. These are distributed partly under the seat and the rest in a box in front of the driver.

In the system of Patin and Requillard, who showed several large and small vehicles, the motor drives the rear wheels by differential gearing. The motors are of the series type, with two commutators and two field windings. The accumulators, consisting of 24 cells, are always connected in series, and the controller gives different speeds by connecting the different windings of the motor in series or multiple. One of the novelties shown by this firm was a tricycle of original construction. The front wheel is pivoted somewhat like a bicycle wheel, and carries above it the motor, which is upheld by forked pieces resting on the axle below. The speed of the motor is reduced by a series of gear wheels; this motion is transmitted to the axle by the belts, of which there are one on each side of the motor. By using one or the other of these belts a different speed is given. The motor is four-pole, and has two collectors; it works on 45–50 volts. It is claimed that a distance of 40 kilometres may be made with this tricycle without recharging the battery.

The exhibits of the American firms occupied a prominent place, and received many favorable comments. The delivery wagon made and exhibited by the Columbia company, was one of those in use by *Le Matin*, a prominent French newspaper. The other American firms represented were the Cleveland Machine Screw Company, using the Sperry system, and the Riker Company. It will be interesting to note that these three companies were the only foreign electromobile makers represented this year.

CONSTANTIN DE KUBICKI.

AUTOMOBILE NEWS.

An electromobile was successfully used as an ambulance in New York city one day last week.

"John is so absent-minded."

"What's the matter now?"

"He bought a load of hay for our automobile."—*Chicago Record.*

It is reported that an automobile system will soon be in operation in Cleveland, Ohio. It is to be run on schedule time in competition with the street-car lines. The automobiles used will be covered and will be heated in cold weather. Each will seat about 40 persons, and it is expected that a number will be in operation within 60 days.

Mr. and Mrs. John Dyer Davis, of New Haven, Ct., who threatened to make "Frisco or bust" on a gasoline automobile, have decided to quit. Mrs. Davis has telegraphed to a friend that the automobile was partly wrecked and that they had abandoned the trip. They are near Toledo, and will, they say, come home at once. The Stamford firm which manufactured the automobile has become disgusted at the idea of any attempt to cross from New York to California, and has declined to assist the tourists any longer.

Alexander Winton, inventor of an automobile, and Charles B. Shanks left Cleveland, Ohio, on August 16 for Chicago. Mr. Shanks will call on General Anderson at the Pullman Building and will receive a dispatch for Gen. Wesley Merritt, to be delivered in New York. The automobile will go from Chicago over the wagon road through Illinois, Indiana, Ohio and New York, and an effort will be made to run the distance in as short a time as is possible. The trip, it is said, has the support of the authorities of the War Department.

A new electromobile express wagon was tested in New York city last week, under the direction of C. H. Crosby, vice-president and general manager of the United States Express Company, the wagon making a regular business trip up town. It has already been successfully tested in Chicago, Philadelphia, Baltimore and Washington, and the latest test was equally satisfactory. Similar wagons, Mr. Crosby said, would be ordered and placed in regular operation in the chief eastern cities. The vehicles resemble, in appearance, the present money wagons of the company. They will be used for money and small valuable parcels. Each can carry, besides two employés, about 800 pounds and costs $2,000.

The Automobile Club of America, with headquarters in New York city, has been incorporated. It is proposed to form a club composed in whole or in part of persons owning self-propelled pleasure vehicles for personal or private use, to furnish a means of recording the experience of members and others using automobiles, to promote original investigation in the mechanical development of motor carriages by members and others, to arrange for pleasure runs and to encourage road contests among owners of automobiles and to cooperate in obtaining rational legislation and rules governing and regulating their use. The directors for the first year are Frank C. Hollister, Winslow E. Buzby, Whitney Lyon, George F. Chamberlin, Homer W. Hedge, William Henry Hall, George M. Smith and Charles R. Flint, of New York city.

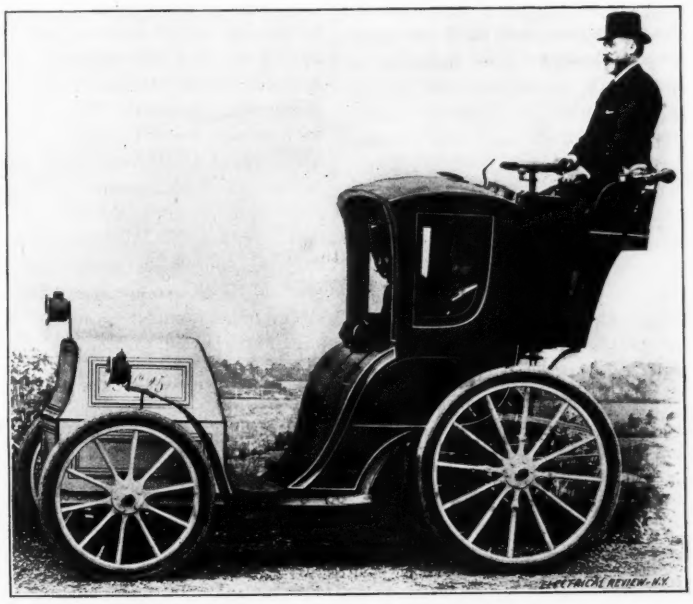


FIG. 2.—JEANTAUD ELECTROMOBILE CAB.

Electric Conductivity and Viscosity of Saline Solutions.

In a recent number of *Wiedemann's Annalen* Herr R. Deunhart describes some experiments undertaken to ascertain if any relation existed between viscosity and conductivity in aqueous saline solutions, and also a study of the conductivity of oleic acid and its alkaline salts in aqueous and alcoholic solutions. Solutions of nitrate, chloride and bromide of ammonia, of bromide, iodide, chloride and nitrate of potassium show the least viscosity. Oleic acid, by itself, is a very poor conductor, but its alcoholic solution is a notably good one.

Robert Wilhelm Eberhard von Bunsen.

On August 16 Professor Bunsen died at Heidelberg, in the 88th year of his age.

Robert Wilhelm Eberhard von Bunsen was born at Göttingen, Germany, on March 31, 1811. His father was professor of theology and of the Oriental languages and literature in the university at that place. Young Bunsen took the course of chemistry and physics at Göttingen, with special mathematical instruction under Gauss, and took the degree of Doctor of Philosophy in 1830. He continued his studies in Paris, Berlin and Vienna. In 1852 he was appointed head professor of chemistry at Heidelberg, which place he held until he died.

While Bunsen was one of the world's greatest teachers of chemistry in all its branches, his original work led him to his greatest discovery, that of spectrum analysis, and to his greatest inventions, the Bunsen burner, the Bunsen battery and the spectroscope. It is said of him that, shortly after being called to Göttingen, he remarked that he considered it to be a duty to his family to become as great a man in his chosen profession as his father was in his. In fulfillment of that duty, he set out at once on a line of original investigation.

In 1838 he began studying the chemical changes which occur in a blast furnace. He showed that at least 42 per cent of the heat evolved from the fuel was lost, and that a great economy could be effected by collecting the combustible gases which escaped and storing them for fuel. These investigations not only greatly cheapened the production of iron, but in them Bunsen devised the first accurate method of analyzing gas.

In 1841 he invented the modification of the two-fluid battery known generally by his name. Grove had already made a two-fluid battery, in which nitric acid was used as a depolarizer in connection with a platinum plate. This cell, while very powerful, was necessarily expensive, and Bunsen's modification sought to cheapen its construction. He replaced the platinum with the carbon from gas retorts, probably the first use of this material in an electric battery.

In the years 1846 and 1847, Bunsen visited Iceland to study the phenomena of volcanoes, and he later continued these studies in Italy. In 1857 he returned to his studies of spectrum analysis. He called to his assistance Kirchoff, the young professor of physics at Heidelberg, to deal with the problems of general physics involved. The result of the investigations was not only the final discovery of spectrum analysis and of the spectroscope, but also the creation of three branches of science – spectroscopy as a department of optics, spectroscopic astronomy and spectroscopic chemistry. By means of the spectrum lines, Bunsen discovered the metals thallium, cæsium and rubidium.

In 1883 he was elected one of the eight foreign associates of the French Academy of Sciences, considered by many scientists the greatest honor to which a man of science can attain. The Bunsen burner and the Bunsen pump for accelerating filtration are now found in every laboratory.

New Officers of the Electric Storage Battery Company.

At a meeting of the directors of the Electric Storage Battery Company, of Philadelphia, held at the Waldorf-Astoria, New York city, on August 17, Mr. Isaac L. Rice resigned the presidency and was succeeded by First Vice-President George H. Day. Mr. Herbert Lloyd, who has been second vice-president and general manager, was elected first vice-president, and will retain the general management of the company. Mr. Rice stated that he had found it absolutely impossible to devote the necessary time to the details of a manufacturing business so extensive as that of the company. He remains a member of the board, and retains his large holdings. He continues also to be president of the Electric Vehicle Company.

SCIENCE BREVITIES.

The Pulverization of Metal Cathodes—Last year it was found by Fritz Haber that the electrolysis of hydrochloric acid with platinum or platiniridium electrodes resulted in an attack of the platinum at ordinary temperature when the acid is concentrated, but the platinum remained unaffected when the concentration is below 30 per cent HCl, says the (London) *Electrical Review*. Platiniridium, containing 10 per cent of iridium, was hardly attacked at all by the concentrated acid, and if the alloy contained 20 per cent of iridium it remained unaffected. At the boiling point an 11 per cent acid solution attacks the platinum as vigorously as a 36 per cent solution at the ordinary temperature, but an eight per cent solution leaves the platinum intact. During the course of the electrolysis a deposition of platinum on the cathode is observed, but this is not due to transference of platinum from the anode to the cathode, as the cathode loses in weight. It is probably due to mechanical action, and in some way connected with the absorption of gases by the platinum. Lead is found to behave in a similar manner, so that formation of a layer of spongy lead on the cathode can be obtained by the electrolysis of sulphuric acid with lead electrodes. Since this Haber has associated himself with Georg Bredig, and has continued his researches, an account of which is given in the *Berichte der Deutschen Gesellschaft*, Vol. XXXI, pp. 2741–2752. When a cathode, consisting of a bright lead plate or wire conveying a current at 24–72 volts, is brought into dilute sulphuric acid, a platinum anode being employed, a momentary pulverization of the lead occurs, and a fine metallic powder falls through the liquid. This takes place at isolated spots on the surface of the metal, bright indentations being left, with rounded edges. A similar phenomenon takes place in alkaline solutions, but in this case it is continuous and much more energetic. The metallic lead thrown down is peculiarly susceptible to chemical change, and can readily be converted into white lead by the simultaneous action of air and carbonic anhydride. The addition of small quantities of a chromate of chromium salt prevents the occurrence of the phenomenon. Mercury, tin, bismuth, thallium, arsenic, antimony and Rose's metal all show the same phenomenon in alkaline solutions, whereas cadmium, zinc, copper, silver, aluminum, platinum and palladium do not act in this way. In acid solution, on the other hand, only bismuth and Rose's metal behave in a similar manner to lead. The phenomenon is to be distinguished from the loosening of the surface which occurs with cathodes of platinum, palladium and lead. In an alkaline solution, it is probably preceded by the formation of an alloy of the metal of the cathode with the alkali metal present, which is then decomposed by the water. This is especially marked in the case of mercury, but no similar action can occur in acid solution.

Rare Brazilian Sand Used for Incandescent Mantles—The Monazite or Prado sand, which is used in the manufacture of the "Auer" incandescent mantles, says the London *Electrical Review*, is found at Bahia, Porto Seguro, and in small quantities in Matto Grosso, Brazil. In the first two places the sand is found close to the shore and is derived from the decomposition of the neighboring gneiss. It is of a dark yellow color, like gold, and very heavy. The following is an average analysis:

Aluminum	3 per cent.
Cerium	62 to 70 per cent.
Iron	2½ per cent.
Lanthanum	2½ per cent.
Thorium	1½ to 3½ per cent.
Yttrium	1 to 2 per cent.

Cerium is an extremely rare metal, hitherto found only in Sweden. Its color is a whitish-green, and it has considerable metallic luster. Its specific gravity is almost equal to platinum. Mixed with copper and zinc an artificial gold is produced, having the same luster and weight as real gold. Thorium is of a gray color, and when burned in air or oxygen is converted into an oxide. The metal combines energetically with chlorine, sulphur and phosphorus, and dissolves in hydrochloric acid, liberating hydrogen in the process. As may be supposed, there has been a considerable run on these valuable sands since they were discovered, and it is expected that the value of this current year's exports will be more than double what it was last year.

Cadmium Standard Cells—Mr. J. Henderson has described in the *Philosophical Magazine* some experiments to find how far reliance might be placed on cadmium cells constructed with nominally "pure" chemicals not specially purified; to try the effect of constructing the cell with moist crystals of $CdSO_4$, instead of a saturated solution of the salt; to investigate the effect of substituting acid for neutral salts, and to investigate the temperature-coefficient, the time-lag of the electro-motive force, and the rate of recovery from polarization. As regards the first question, it was found that ordinary "pure" chemicals were quite as good as specially purified ones. In one case, the commercial cadmium and mercury sulphates were found to be strongly acid, and yet they had the same low deviation from the mean (0.0001 volt) as cells prepared with Kahlbaum's purified chemicals. This constitutes a decided advantage of the cadmium cell. As regards time-lag, it was found that a cell heated from 16 to 30 degrees took two hours to accommodate its electro-motive force to the changed temperature. Very satisfactory results were, however, obtained with regard to recovery after polarization. The electro-motive force of a cell connected in series with a 1,000-ohm coil for five minutes was found to have completely returned to its original value two minutes after the circuit was broken.

Diffraction of Roentgen Rays—The debatable question of the diffraction of Roentgen rays forms the subject of some recent experiments described by Prof. H. Haga and Dr. C. H. Wind in the proceedings of the Royal Academy of Sciences of Amsterdam. In such experiments it is better, in order to obtain greater intensity, to use narrow slits than to make the distances great. As the time of exposure varied from 29 to 200 hours, the apparatus had to be mounted on a heavy freestone block supported on the central pillar of the Physical Laboratory of the University of Groningen, where the experiments were made. The diffraction slit was three centimetres high and 14 microns at the upper end, gradually narrowing to a width of a few microns. A careful examination shows a kind of broadening out of the image corresponding to the narrowing of the slit, and this it is considered can only be attributed to diffraction of the Roentgen rays. The authors give estimates of the wave lengths of the rays lying between 0.12 and 2.7 Angstrom units, but consider that they can not succeed in making measurements instead of estimations of the wave length until Roentgen tubes have been produced remaining in working order as long as those used, and giving out rays of much greater energy.

Utilizing Blast-Furnace Gases—In *l'Eclairage Electrique* M. Aimé Witz, who has contributed a great deal to the utilization of blast-furnace gases in gas engines, has stated the matter very concisely. He has taken a total charge of 92,000 kilogrammes of coke, equivalent, we will say, to the production of 100 tons of pig-iron, and has calculated out what he terms a thermic balance sheet. This amount of coke contains 629,000,000 of heat units, and to this amount is added the heat units recovered from the reheaters, or 416,000,000 more. This makes a total of 1,045,000,000 of heat units. The chemical reactions within the furnace require 182,000,000, or 17.4 per cent; the production of steam requires 50,000,000, or 4.8 per cent; for the reheaters there will be required 473,000,000, or 45.3 per cent; while 340,000,000, or 32.5 per cent, will escape as waste gases. In other words, more than one-half of the heat units in the coke are not utilized at all. As regards the use of the gases for raising steam, the consumption was found to be at the rate of 22 cubic metres (776.6 cubic feet) per indicated horse-power per hour. This is equivalent to an efficiency of about three per cent. If the furnace gases were used in gas engines the consumption per indicated horse-power per hour would be about 3.5 cubic metres (123.5 cubic feet), and the horse-power would be 2,381 instead of 380, as at present.

Wireless Telegraphy and Its Application to Balloons—Experiments were recently made by Professor Tuma and a number of officers of the Vienna garrison, to test the possibility of wireless telegraphy between two balloons, says the *Mechanical Engineer*. A balloon held captive at a height of 150 metres served in place of the mast used in the Marconi experiments, being connected with the dispatching instruments on the ground by a copper wire. The second free balloon carried a receiving instrument and a wire which hung loose 20 metres below the car. In these conditions it was found possible to communicate with the three officers in the free balloon, who signaled with flags that they had received and understood the telegraphic messages. These signals were observed at an estimated height of 1,600 metres, and a distance of about 10 kilometres from the dispatching station. Owing to the size and weight of the accumulators, and the great danger of bringing them into close proximity to a large volume of explosive gas, it is thus far impossible to telegraph from a balloon to the ground or from one balloon to another.

The International Electrical Congress at the Paris Exposition.

The Universal Exposition of 1900 is sure to bring together in Paris a great number of the scientific men and engineers of the whole world. This justifies the French electricians in their efforts to organize an international electrical congress, which has received the official patronage of the French Government. In previous conferences questions of units and nomenclature have been settled by international agreement, to the immense advantage of all concerned. During the last 20 years there have been unexpected discoveries, new applications of what seemed once to belong to pure science, and an extraordinary expansion of electrical industries. Practice has thus started up a great number of problems on which it will be interesting and profitable to have the views of technical authorities. The discussions of the congress will therefore have especially an industrial and economical character. The work is, provisionally, divided as follows:

1. Scientific methods and instruments of measurements.

2. Production of electric energy, transformers. Transfer and distribution. Electric lighting, traction.

3. Electro-chemistry. Electrometallurgy. Accumulators. Electric furnaces.

4. Telegraphy. Telephones and various applications.

5. Electro-physiology.

The congress will last one week, beginning Friday, August 18, 1900. The subscription for membership is 20 francs.

Automobiles in Scotland.

The automobile has become a familiar object in the streets of Scottish cities, and it is often seen also on the country roads, according to a United States consular report. This vehicle was introduced in Edinburgh by a local company early in 1898. During the Spring and Summer of last year, a vehicle with a seating capacity of eight was run regularly between the post office and the Forth Bridge, a distance of about nine miles. This method of transit gradually won public favor. As the traffic increased, other automobiles were added. The company, finding the Forth Bridge experiment a success, decided to run vehicles on certain routes in the city. Since these routes were established, the public patronage has increased steadily, and the returns of the company during the current year have been quite satisfactory. The rate of fare is practically the same as the rate on the corporation tramways, averaging one penny (two cents) per mile. This is about the rate also in Glasgow, Dundee, Aberdeen, Hamilton, Falkirk and other cities where automobile companies are operating. That the automobile has a promising future in Scotland, there seems little room to doubt. They can be run into the rural districts in every direction, both for passenger and goods traffic. There are almost as few country roads as city streets on which these vehicles can not safely and easily go. An indication of the widespread and growing interest in the automobile throughout Scotland is found in the increasing attention given to the subject by the press. The expansion of the motor-making industry, the changes and improvements in the vehicles, and the development of the street-transit lines, are now matters of frequent comment.

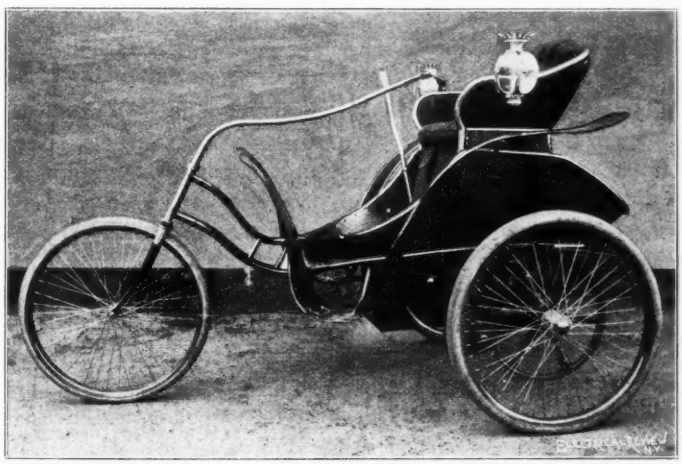
It is announced that the directors of the Glasgow Exposition of 1901 are making extensive provision for an exhibit of these vehicles in the locomotive and transportation department, with facilities for the practical demonstration of their merits. The automobiles now in use in Edinburgh and district are of British manufacture. There seems no reason why an opening should not be found there for American vehicles of this class.

The village of Montague, P. E. I., Can., is installing an electric plant for light and power purposes. Power is derived from a water-power three-fourths of a mile from the village. W. P. Doull, a local electrician of Charlottetown, is superintending the installation.

The Eastman Electromobile.

Mr. H. F. Eastman, of Cleveland, Ohio, has designed the electromobile shown in the illustration herewith. It is a three-wheeled vehicle built on bicycle lines, and Mr. Eastman calls it an "electrocycle."

The frame-work is of weldless steel tubing one and one-fourth inches in diameter and No. 14 gauge. The panels are crimped sheet steel, riveted to angle irons that are brazed to and reinforce the frame-work, thus making an all steel body, very light, strong and impervious to weather or climatic variations, and one which can be baked in any color of bicycle enamel. The battery used is the well known Willard; 20 cells of 66 ampere hours each, with a total of 40 volts being provided, but these can be charged up to 50 volts, which, with favorable conditions and moderate speed, will carry the vehicle about 40 miles. The motor is a special make of the Lincoln Electric Company, is plain series-wound with powerful fields, and the armature is wound for 20 amperes. It has a cast-steel shell, with an aluminum cap over the commutator. Giving one and one-fourth horse-power at 1,200 revolutions per minute, it is very compact and of high efficiency. It is provided with ball-bearings.



THE EASTMAN ELECTROMOBILE.

The controller lever on the first notch throws all the cells in multiple, with a speed of four miles an hour; on the second notch the cells are two in multiple and 10 in series with 20 volts thrown in, the speed being eight miles per hour. The third notch throws all the cells in series with full voltage on the motor, the speed being about 15 miles per hour. There is one speed backward corresponding with the first speed forward, and a coasting motor-brake. These are all operated by the one lever, into the end of which is fitted a push-button that rings a gong under the floor. A snap-latch under the seat lights up a pair of brilliant lamps, which, with six candle-power and 10 volts, consume only one and two-tenth amperes and make a very satisfactory illumination.

It is the company's design to build the type described above as its standard, as the tenor of inquiries seems to favor this particular design. It is so simple, strong and easily handled that it has sprung at once into popularity. A four-wheel design is also in view, having greater battery and motive power and accommodating four people.

Heavy Electric Railway Work in Paris.

The work upon the new underground electric branch of the Orléans Railway is being carried forward rapidly. The road, which terminates at the exposition grounds, includes, besides the tunnel, two large stations, one of which, the Gare D'Orléans, is on the bank of the Seine opposite the Louvre. Here an immense area may now be seen covered with ironwork, which constitutes the roof of the underground station and the flooring for the handsome superstructure which will shortly be erected; the first courses of masonry are being laid on the side farthest from the river. Farther down, at the exposition grounds, is the terminus of the road, over which will pass the principal avenue of the exposition, leading from the Champs Elysées, past the Great and Small Palaces and crossing the river by the new Alexander III bridge, now being built; it then passes over the underground road at the station and finishes at the Hôtel des Invalides, the imposing structure in which is the tomb of Napoleon. Another electric branch is to connect this station with the existing railroad to Versailles, and is to be operated by electric locomotives, each of which will have four suspended motors. The current will be taken from side conducting rails laid parallel to the track.

A London capitalist has offered to construct at Southend a huge seawall, at a cost of $3,000,000, asking in return permission to use the tidal force for working a generating plant, with the idea of supplying London with electricity. He guarantees there shall never be less than three feet six inches of water on the beach.

Electrical Review

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News, Subscriptions and Advertisements.

SPECIAL NOTICE TO ADVERTISERS.

CHANGES for advertisements must be in this office by Friday noon for the following week's issue. NEW ADVERTISEMENTS should be in the office not later than Saturday noon to insure publication the following week, although it is occasionally possible to get in matter received on Monday.

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THE SCARCITY OF COPPER, IRON AND STEEL.

American manufacturers of electrical goods and those in the allied trades are confronted by a situation that is both singular and embarrassing. With a widely growing market for exports, and with home consumers clamoring for goods, they can not obtain the raw materials of their industry and perforce must reduce their output. From every side comes the story of construction work hampered for lack of steel and pig iron and copper. A few days ago a large shipyard on the Atlantic coast found it necessary to lay off 1,500 men because steel plates and frames could not be had, and other yards are shut down entirely while waiting for these necessary supplies. In the machine shops the same state of thing exists, only aggravated because of the utter impossibility of obtaining new tools.

But it is with copper that the electrical industries are chiefly concerned. The great demand for this metal has carried the price of wire above 19 cents per pound, with deliveries indefinite. Indeed, wire in large quantities simply can not be had at all if it is needed at once.

It is stated, on good authority, that the large copper producers of the country have reached their limit of output. One of them, the Anaconda company, is said to have even reduced its output. Yet the great copper miners are anxious to keep the price of the metal below 20 cents, to avoid the damaging results that higher prices would be sure to entail upon their industry.

At the same time aluminum is entering the field more and more largely as a competitor of copper for electrical uses, and of brass for general purposes. A large railway in Chicago has lately ordered 150,000 pounds of aluminum feeders, and a new plant in Canada is to use an aluminum transmission line. One prominent aluminum smelting concern is just about to invest $3,000,000 in an extension of its works, while the present plants are working at full capacity.

While the increasing demand for copper is painfully apparent, the inability of the producers of this metal to respond is equally noticeable. To the careful observer of the conditions, it appears that, for electrical purposes, a substitute for copper must be had, and that aluminum is the substance to which the industry must now look. Assuming that at present the prices of this metal and copper are about the same for equal electrical availability, then it is evident that there is far more room for developing the producing industry and lowering the output cost in the case of aluminum, if only on account of the small present development of the aluminum industry. Certainly the situation presents a remarkable opportunity for the aluminum producer.

TROLLEY ACCIDENTS.

The recent slaughter of nearly 30 people on an electric railway line in Connecticut has attracted renewed attention to the question of safety in such installations. Accidents that might have been condoned in the early and experimental years of electric traction are no longer to be looked upon as unavoidable visitations. For the most part, accidents are the direct results of negligence, incompetence or ignorance. It is extremely rare that they are due to defective material.

In this day of heavy cars running at high speeds, and often through crowded thoroughfares, the position of the motorman is one of great and increasing responsibility. In their very natural desire to reduce expenses, the railway corporations have far too often given this important situation to men entirely unfit to be trusted with the lives of passengers. It is an axiom that a low-priced man is worth only about as much as he will work for, and that to obtain men fit for positions of responsibility means the payment of commensurate wages. In the early days of electric railways, men who were competent to drive a two-horse team were thought to be good enough to handle a controller, and very probably they were. But with the increase in speeds and weights of cars, and the rapid approach of the electric railway to the standards of steam railways in point of speed and weight of trains, there has been no equivalent betterment of the type of motorman. In this connection, the New York *Tribune* recently made the following sensible remarks:

"The standard of character and skill has never been high enough on trolley roads. Would anybody venture to assert that trolley motormen are of the same grade, on the average, as locomotive engineers, or even approach it? Everybody knows that such a pretence would be preposterous, but it can scarcely be doubted that heavy trolley cars running swiftly through crowded streets need, for their safe operation, at least as large a possession of intelligence, judgment, dexterity and care of those who control them as do the trains on steam roads running for the most part on well protected tracks through the country."

There is little to add to this statement; it is literally true. The best insurance against such horrible disasters as that in Connecticut, is to better the class of men in control of the cars.

In Omaha, Nebraska, they are having a small war between the electricity-supply companies and the municipal authorities. The latter are endeavoring to force all the present overhead wires underground. This question, in one form or another, is continually coming up in the smaller cities, and it is rare that the simple criterion of common sense is applied to the situation. It costs much money to put lighting, power, telephone and other circuits in conduits. It is undeniably better to have them there. If they are put there all electric service is made more costly, to repay the supply companies for their extra expense. Hence the citizens of the city that forces overhead wires to seek the conduit must be prepared to pay for its wireless streets in larger telephone, light and power bills. Underground circuits are excellent, but expensive things, and the companies owning them will not, in general, pay too large a share of their cost.

The town of Wabash, Ind., had, up to a few days ago, an acetylene plant—the first of its kind in the United States—for the municipal supply of that illuminant. One night the plant exploded with a tremendous report, leaving the town gasless and in the dark. While Wabash deserves some sympathy, it was about time for some place to show, on a large scale, the capabilities of acetylene. As an illuminant it compares unfavorably with electricity, but as an explosive it has the field largely to itself.

A New Water-Power Electric-Transmission Development in New York State.

There has just been incorporated a company, known as the Empire State Power Company, for the development of the water-power of the Schoharie River, a swift stream flowing into the Mohawk River, near Amsterdam, N. Y. It is expected that 15,000 horse-power will be developed and transmitted to the nearby towns.

Four dams are to be built. The first will be located at what is now known as the Van Dorn water plant in the town of Glen, just above Fort Hunter. Here a new dam is to be built across the stream at the location of the old dam and of the same height, giving a fall of 20 feet. An electrical power generating plant is to be built here and the power it is planned will be transmitted to Fonda, Fultonville, Johnstown and Gloversville.

The second dam will be further up the creek, at what is known as Schoharie Falls. Here a fall of 40 feet will be obtained. Another generating plant will be put up at this point to supply Amsterdam with power and light.

Two miles further up the creek the Bromley power will be put in use. Here the dam, as it is proposed to construct it, will give a fall of about 45 feet. The power from this point is likewise to be transmitted to Amsterdam. The largest piece of work of all will be that near Burtonsville. One mile above that old-time settlement a dam is to be built giving a fall of 85 feet. This will be the main plant of the four, and here 10,000 horse-power is to be obtained. This supply of power it is proposed to transmit to Albany and Troy and to Cobleskill and other Schoharie County villages.

In order to supply the creek with a steady flow it is necessary to obtain two immense storage reservoirs back in the Catskills, and this plan is now being put into execution.

The first power plant will be constructed at the Schoharie Falls. Operations will be under way there within the next week. Engineers are now preparing plans and specifications and contracts for the excavations for the dam, raceways, etc., will probably be let within 10 days. It is expected to have the Schoharie Falls plant ready to supply electrical power on or before January 1, 1900. Thirty-five hundred horse-power will be furnished from this generating station.

The officers of the company are as follows: J. George Kaelber, of Rochester, president; Samuel Bolton, Jr., of Lansingburg, vice-president; William T. Mayer, Albany, treasurer; Dewitt A. Devendorf, Fort Hunter, secretary.

President Kaelber, than whom it would be difficult to find a more experienced electrical promoter, has been at work on this undertaking with Mr. Devendorf for the past year. Mr. Kaelber, during the last 20 years, has been identified with leading electrical companies, successfully promoting and operating many electric light and power plants throughout the United States. He was the organizer and for years the president of the Beacon Electric Company, operating in Troy and vicinity, and also of the Beacon Light Company, operating at Chester, Pa., and extending to Philadelphia. He has also been the leading spirit of numerous other companies from Bangor, Me., to Vancouver, B. C., and is still largely interested in some of the most successful of these.

Street-Railway Consolidation in New York State.

Mr. Anthony N. Brady is reported as admitting that operations looking to the consolidation of all the street railroads in Albany and Troy, N. Y., have been going on for some time and that he expects an early consummation of the plan. It is believed that the deal involves a number of other properties in that section, including the Troy & New England road as well as lines in Saratoga, Rensselaer, Washington and Warren counties, and some properties in Vermont, which will give the consolidated company a practical monopoly of street-railway traffic over a large territory.

Mr. Morgan's Offer to Light St. Paul's Refused.

The dean and chapter of St. Paul's, London, have concluded not to have the cathedral lighted by electricity. Mr. J. Pierpont Morgan, of New York city, offered to pay the cost of the installation of the electric plant. The redecoration of the cathedral, which is being done, will, it is asserted, make electric lighting an artistic impossibility.

It is reported in Trenton, N. J., that the Pennsylvania Railroad Company has decided to build a trolley road that will have such connections and traffic arrangements as will make a continuous trolley line from Jersey City to Washington. The company is said to have made an agreement with the Trenton Street Railway Company.

PERSONAL.

Mr. Edward S. Dimmock has been appointed general manager of the Bay Cities Consolidated Railway Company, of Bay City, Mich.

Mr. Arthur Warren, of the Westinghouse Electric and Manufacturing Company, has returned from an extended European trip.

Mr. I. J. Kusel, president of the Eureka Electric Company, telephone manufacturers of Chicago, is visiting New York city this week.

Mr. W. Bampfield has been appointed general manager of the North American Telegraph Company, with headquarters at Kingston, Ont.

Mr. J. G. White, of J. G. White & Company, the well known engineers and contractors of New York city, sailed for Europe last week, and will be away about a month.

Mr. Charles W. Torrens, a member of the Winfield-Bowles Company, electrical engineers of London, Eng., is visiting the United States, and spent last week in Pittsburgh.

Capt. Robert McCulloch, of St. Louis, who for many years was manager of the National Railway Company, operating half a dozen street-railway lines, has resigned the new position of division superintendent, to which he was recently appointed under the recent consolidation.

At a meeting of the directors of the Chicago Consolidated Traction Company, held last week, John M. Roach resigned his position as president, and was succeeded by Charles T. Yerkes. Warren F. Furbeck resigned his position as vice-president, and L. S. Owsley was elected to succeed him. Mr. Roach, D. H. Loudeback and C. H. Marlowe resigned from the directorate, and their places were taken by John R. Walsh, B. B. Lamb and Harvey T. Weeks. Mr. Yerkes will, it is said, take active charge of the company's affairs.

Chicago Edison Company.

It was rumored in New York city last week that the Whitney-Widener-Elkins syndicate was endeavoring to obtain control of the Chicago Edison Company and its allied interests, with a view to making a combination with the Union Traction Company, of Chicago. The report has not been confirmed or denied by any one in authority in either company.

The People's Telephone Company voted last week to combine with the Citizen's Telephone Company and the Eastern Telephone and Telegraph Company, all of New York city. The three companies are independent and own charters but have constructed no lines.

Wall Street and the Electrical Stock Market.

The features of the week in the stock market were the decline in money rates and the advance in stock values. The state of trade continues to be exceedingly active, the industrial companies are highly prosperous and railway traffic returns reflect these conditions. The money market has steadily grown easier during the week and bankers throughout the country continue to be lenders of money on stock exchange collateral. The dealings in the market toward the close of the week were unusually animated for this season of the year.

On the New York Stock Exchange General Electric closed the week at 123 bid and 124 asked, showing no change for the week. Metropolitan Street Railway of New York closed at 206 bid and 207 asked, a loss of 2½ points for the week. Third Avenue Railroad of New York closed at 185 bid and 195 asked, showing no change for the week.

On the Boston exchange American Bell Telephone closed at 345 bid and no asked price, a gain of 2 points for the week. Erie Telephone closed at no bid price and 98½ asked, a gain of ½ point for the week.

On the Philadelphia exchange Electric Storage Battery common closed at 145 bid and 155 asked, a gain of 5 points for the week. Union Traction closed at 41¾ bid and 42 asked, a loss of ½ point for the week.

On the curb or outside market in New York Electric Vehicle closed at 108 bid and 110 asked, a gain of 8 points for the week. Electric Boat closed at 29½ bid and 30½ asked, a gain of 12½ points in the bid price for the week.

Wall Street, August 19.

A New Electric Manufacturing Company.

The Scott-Janney Electric Company, of Philadelphia, which was recently incorporated at Trenton, N. J., with a capital of $30,000,000, has elected a board of directors and, it is stated, will erect a large plant in Philadelphia at once. Among the directors are Messrs. Daniel O'Day, of Buffalo, N. Y.; W. H. Woolverton, of New York city; Gen. Frank Reeder, of Easton, Pa.; Gordon J. Scott and William S. Janney, of Philadelphia.

The Central Union Telephone Company, of Indiana, has filed a mortgage to cover $500,000 bonds. Last February the company voted the issue of $6,000,000 and this $500,000 brings the issue of bonds to $4,000,000.

ELECTRIC RAILWAY NOTES.

A syndicate of Chicago capitalists has been organized for the purpose of purchasing the lines of the Chattanooga electric street railway.

The Kittanning & Ford City, Pa., Street Railway, which has been in course of construction since early in the Spring, has been completed from the Valley depot, at Ford City, to McCain, and regular trips have been made over the road since the middle of August.

The Wellston, Creve Coeur Lake & St. Charles, Mo., Railroad, which has just been completed from the city limits west to Lucas Lane, a distance of two miles, on the St. Charles Rock Road, has been opened to the public, together with Lucas Grove, the present terminus of the line.

President Sam Devine, of the Chattahoochee, Tenn., Rapid Transit Street Railway Company, announces that he will at once begin the erection of an elevated street railroad from Chattanooga to the foot of Lookout Mountain. Eastern capitalists are putting up the money.

The Union Traction Company will build a line from Daleville, Ind., on the Muncie division, to Middletown, seven miles distant, and from Orestes, on the Elwood division, to Frankton, six miles. The company will have 165 miles of electric railway in operation by January 1, if present plans are not sidetracked.

Elbridge J. Whitaker, of Wrentham; Charles E. Bibber, Rufus H. Sawyer, of Malden; H. A. Burgett, of Brookline, Mass., and others are forming a corporation for the purpose of operating a street railway, the corporation to be known as the Foxboro, Wrentham & Lake Pearl Street Railway Company. The proposed railroad, which will be about four miles long, is to commence near the boundary line between Wrentham and Foxboro, in Wrentham, and to extend through Wrentham to a point near Lake Pearl, its terminus. The capital stock of the company will be $35,000.

The Lebanon, Pa., Valley Railway and the Berks & Dauphin Turnpike Company have settled all the differences that have existed between them over the right of way for occupancy of the turnpike by the railway company between Avon and Palmyra. By agreement of counsel the turnpike company received $17,000 damages and the electric company must build a bridge across the creek west of Annville for its railway. This settlement insures the early construction of the Palmyra extension, making a continuous electric system of 16 miles. There are assurances that in a short time Womelsdorf and Hummelstown will be connected, making a continuous system from Reading to Harrisburg.

A Large British Contract Awarded to American Companies.

The contract for engines for the fine municipal system of street railways in Glasgow, Scotland, has just been awarded by the authorities of that city to the E. P. Allis Company, Milwaukee, through Mr. F. A Larkin, the New York manager for that concern.

The city of Glasgow is one of the few municipalities owning a complete system of street railways. Part of the system, which is of considerable magnitude, is under ground, and this tunnel section has heretofore been worked by cable. The contract for engines is for six units, aggregating 15,000 horse-power. These are to be direct-coupled to the generators, for which a contract has also been awarded to the General Electric Company, through Mr. W. J. Clark, the European representative of that corporation.

It is pleasant to chronicle the success of American manufacturers in selling electrical machinery and engines in the very stronghold of the British engineering trade.

The National Water Tube Boiler Company.

The National Water Tube Boiler Company, of New Brunswick, N. J., has secured the support of a strong local syndicate, and will again enter the manufacturing field. The company has recently changed hands, and the new directors of the company are Hugh McKeag, Philip Weigel, Jr., Robt. J. Smith, P. M. Welsh, P. G. Polhemus, C. A. Schenck and Hugh Boyd. The officers are: President, Hugh McKeag; vice-president, P. G. Polhemus; secretary and manager, C. A. Schenck; treasurer, Philip Weigel, Jr. Mr. Schenck has been with the National Water Tube Boiler Company for 11 years. During the latter part of that time he has been acting as manager. Mr. Schenck is a man of ability, and is thoroughly acquainted with the workings of the business as a result of his wide experience, and will, no doubt, do much to improve the condition of the concern.

ELECTRIC LIGHT FLASHES.

The electric light plant at Brownsville, Tenn, was destroyed by fire a few days ago at a loss of $5,000.

At a meeting of the Oshkosh, Wis., Electric Light and Power Company, the following new officers were elected: President, H. B. Harshaw; vice-president, George B. McHilton; treasurer, A. E. Thompson; general manager, W. H. Huntington. Leander Choate was elected director in place of Mr. Paige.

A new 100-barrel flouring mill is almost completed at Eagle Grove, Iowa, built by the Roger–Fleming Milling Company. Power will be furnished to it by the Eagle Grove Electric Company by means of rope transmission. The Eagle Grove Electric Company will about September 15 start a day circuit and furnish power to all industries.

The Durham, N. C., Electric Light Company has received a three years' contract to light the streets of that city. Under the new contract the company is to furnish the city 60 enclosed arc lights at a monthly rental of $8.35⅓ for each light, or $6,000 for the entire service. Each light is to be of 2,000 candle-light-power and to burn all night, every night in the year.

A syndicate, comprising Herbert S. Shaw, John W. Dobbie and N. T. Hurlbut, of Webster, Mass., and H. S. Pratt, of Worcester, has closed a long anticipated deal whereby they purchased the controlling interests of the People's Light and Power Company's plant in Danielson, Ct. Mr. Shaw is superintendent of the local electric light plant, and Messrs. Dobbie and Hurlbut are directors. The purchased plant is capitalized at $90,000. It will be entirely remodeled and improved.

The annual meeting of the stockholders of the Sebago, Me., Power Company was held at the office of C. F. Libby, First National Bank Building, last week. The important business of the meeting was the authorization of the board of directors to purchase the property of the Cumberland Illuminating Company, and put under one management the Cumberland Illuminating Company, the Portland Electric Light Company and the Deering Electric Light, all to be controlled and managed by the Sebago company. The following directors were duly elected: Frank W. Stockman, George W. Brown, Jesse Peterson, M. H. Kelly, E. B. Denison and W. F. S. Brown. At a subsequent meeting of the directors Geo. W. Brown was elected president and M. H. Kelly, treasurer.

The Genesee Power Company, a corporation organized for the purpose of building an immense storage dam in the Genesee River, near Portage, will build the new power dam at Mount Morris. The work will be rushed and the dam completed this Fall, if possible. The dam will cost about $40,000, as planned by the company. The storage dam will cost about $3,000,000, and the company has three years yet in which to construct the same. As the new owners of the dam will look to the water-power users at Mount Morris for whatever income they will realize from their investment, it is probable that they will introduce as many new manufacturers in that place as can be supplied with water-power.

Telephone Manufacturing in Japan.

The manufacture of telephone apparatus has so far advanced in Japan that, with the exception of springs, for the supply of which foreign aid is still depended upon, all other necessary paraphernalia can be made at home at about one-half the cost of foreign goods, says *Industries and Iron*. At present, therefore, only a very small portion of telephone apparatus is being imported. Foreign instruments are used only in such places as Tokio and Osaka, where the telephone connections are in brisk demand. Again, when the Communications Department is in need of a large supply for immediate use, it is obliged to patronize the foreign makers, it being not easy to procure the supply of Japanese instruments within a short time in any large quantity. The manufacture is carried on both at government and private shops, between which no particular difference is noticeable regarding workmanship. It is thought in some circles that to encourage the development of the industry, the government shops ought to be closed, and greater patronage accorded private enterprises. There are in Tokio quite a number of such factories, of which only two or three are doing business on a large scale. There exist also a few in Osaka, as usual turning out a cheap and inferior quality.

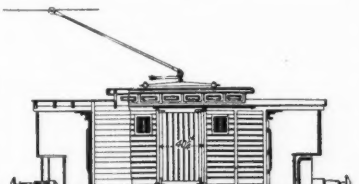
The contract for building the Coplay, Egypt & Ironton, Pa., Railroad has been awarded to Hon. Hugh E. Crilly, of Allentown, and he has already started work in Coplay. The road will be about three miles long.

Accumulator Traction at Ghent, Belgium.*

A short article on accumulator traction at Ghent is contributed to the *Elektrotechnische Zeitschrift* by J. Zacharias, and is given in abstract below. The tram lines at Ghent have a gauge of one metre (39⅜ inches), the length of track amounting to 17½ and that of the lines to 22½ miles. There are several sharp curves and gradients up to four per cent. The tramways are worked entirely by means of accumulators. The charging-station equipment comprises three water-tube boilers, three steam engines, each of 300 horse-power output, coupled by means of belts to three dynamos, giving each an output of 200 kilowatts at 250 volts terminal potential, besides two booster dynamos.

There are 22 motor cars running and two in reserve, with 33 batteries. It is intended, however, to increase this number to 38, with 70 batteries, of which about one-fourth will remain in reserve. The working day is from 6.50 A. M. until 10 P. M., the town possessing some 150,000 inhabitants. The cars are designed to seat 22 passengers, standing room for a further 12 being provided. Each car is equipped with a battery of 108 cells, made up of 12 boxes of nine cells, the total weight amounting to about two tons. Such a battery suffices to drive the car 30 to 36 miles on one charge, and since each car traverses about 70 miles daily, the batteries, as a rule, require changing once a day. The normal speed attained by the cars in the town amounts to seven and one-half miles per hour, speeds up to 19 miles per hour being accomplished in the suburbs.

The station where the spent batteries are taken out for recharging contains six sets of rails, each for eight batteries, which latter are placed in withdrawable boxes supported at a suitable height above the floor level on wooden trestles. At the end of the charging-room is situated a raised gallery for the switchboard, partitioned off by a glass partition. Each battery has its own circuit, so that the switchboard is furnished with regulating resistances, switches and measuring instruments for 48 circuits, and almost covers the end wall of the charging-room. In order to secure the utmost economy, the charging process is accomplished as follows: The charging is started with a current of 60 to 80 amperes, at 250 volts pressure. When this current has sunk to 45 amperes the voltage is increased, with the aid of the boosters, to 275 volts, and the current strength at the same time brought up to 45 to 50 amperes. Then the charging is continued until the current has sunk to about 10 amperes. The process is thus completed with two different, though constant, potentials. Of special interest in connection with the installation under notice is the construction of the accumulators. These are of the new system Julien type, which belongs to the modern Planté variety, and are arranged as follows: The positive electrode, in the form of a block built up of numerous layers of corrugated lead sheet, is enclosed in a vulcanized rubber cell 12½ inches high, and possessing an area through its horizontal section of five inches by three and three-fourths inches. The lead sheets are perforated for the reception of the negative electrodes.



FREIGHT MOTOR-CAR ON A GERMAN ELECTRIC ROAD.

The latter are of cylindrical or prismatic form. In the construction of a positive electrode about 120 sheets of lead are employed, which are so superimposed that the corrugation of successive sheets cross, whereby numerous channels possessing very considerable surface are created, so that, in a space possessing an area through its horizontal section of four and one-half inches by three and five-eighths inches and nine and one-half inches depth, about 7,000 square inches of active surface are present. At the four corners of the block the plates are held together by means of lead fillets. The negative electrodes consist of perforated lead piping, which contains the negative active mass in the form of porous spongy lead, so that its volume bears the correct proportion to the peroxide of the positive Planté electrode. The negative prisms are protected by means of a perforated vulcanized rubber insulating jacket, besides being provided with vulcanized rubber shoes to prevent short circuits.

The author has had an opportunity of observing the behavior of this type of accumulator under actual conditions of working, besides having had experience in regard to its manufacture. With a weight of cell amounting to 55 pounds, including acid, a capacity was obtained of 300 ampere hours in 20 hours with 15 amperes; 250 ampere hours in five hours with 50 amperes. This high efficiency is due solely to the original method of construction, which enables of such a large active surface being obtained. While, for instance, ordinary ribbed plates possess 85 square inches, or at the most 110 to 130 square inches of positive active surface per pound of weight of the electrodes, the block accumulator, on the other hand, has 320 square inches.

One of the chief advantages claimed for this new type of construction consists in the great elasticity and freedom of expansion common to individual corrugated lead sheets comprising the positive block. The disposition and insulation between the electrodes of different polarity are extremely simple. The positive electrode rests upon the bottom of the vulcanized rubber cell, while the negative prisms are effectively protected against the possibility of short-circuits by the jacketing of vulcanized rubber already mentioned. All the prisms belonging to one cell are soldered above to a lead fillet, which rests upon glass tubes placed upon the upper surface of the positive electrode, so suspending the prisms. Any flakes of spongy oxide which may deposit themselves on the floor of the cells can not cause a short-circuit, since the lower ends of the negative prisms are enclosed by shoes of vulcanized rubber one inch in depth. This construction also enables rapid cleansing of the cells. Besides for the working of the tramways at Ghent, the new Julien accumulators are employed upon the Belgian State Railway to drive a motor-car at a speed of 55 to 65 miles in the hour. After having accomplished 5,000 car miles the batteries used at Ghent appeared to be in an excellent state of preservation.

*The (London) *Electrical Engineer*.

Street Railway Association of the State of New York.

The Street Railway Association of the State of New York will hold its annual convention at Ithaca, N. Y., on September 12.

An American company has shipped to the Russian Government at St. Petersburg 200 cases of aluminum to be used as conductor lines for an electric railway controlled by the Imperial Government.

A German Freight Trolley Car.

Some attention has lately been given to the possibilities of using electric lines as feeders to steam railroads, and the following from Germany, says the *Railroad Gazette*, may be suggestive of how, in special cases, this may be done:

The illustration shows a motor-car in use on the Aibling–Feinbach electric line in Germany for freight service. This line branches off from the main line of the Bavarian State Railroad at Aibling Station, and is of the standard gauge, so that the cars in use on the latter can be switched in on the electric line. The line is about eight English miles long, with a maximum grade of 1.7 per cent, and a minimum curvature of 984 feet radius. The track is laid with 45-pound steel rails on cross ties at 33-inch centers.

The freight motor-cars are equipped with two motors each, enabling them to haul three of the 15-ton freight cars in use on the state railroads, fully loaded, at a speed of 12½ miles an hour.

These cars have a carrying capacity of five tons. They are built on strong channel iron frames, and supported on elliptical springs. The axles are of nickel steel with three and three-fourth-inch journals, and the wheels are steel tired with wrought-iron centers. The cars are equipped with hand brakes only, with a pair of shoes on each wheel. The seven stations on the line are arranged for the accommodation of passengers as well as freight, having besides the waiting-room also a freight office. The stations have telephone connections with the central station.

Except at the terminals there are no station attendants on regular duty, the receiving and dispatching of freight being attended to by private parties engaged in other business, who act as freight agents only when their services are needed and receive their pay on a commission basis.

The amount of freight handled varies with the seasons of the year, but shows a steady increase. During last year there were handled about 2,500 carloads, among which were 15,000 tons of lumber, 4,500 tons of grain, the same amount of brick and about 3,000 tons of coal. Besides the freight transportation the line maintains a regular passenger service with ordinary motor-cars, and carries also the mail.

President John E. Hudson, of the American Bell Telephone Company, has been elected a member of the corporation of the Massachusetts Institute of Technology, of Boston.

Telephone News .....and Comment

In about a month Carrollton, Ky., will have long-distance telephone connection. The line to Madison will be completed by that time.

The American Telegraph and Telephone Company expects to allow talk between St. Paul and Chicago by August 20. The rate for a five-minute conversation will be one cent per mile, as the crow flies, to all eastern points.

The Colorado Telephone Company is overhauling the line between Central City and Black Hawk and increasing the lines between Central City and Denver. A copper circuit now connects Denver with Leadville via Georgetown and Central City.

Mr. J. W. Waller, manager of the Henderson, Ky., Telephone and Telegraph Company, writes to the ELECTRICAL REVIEW that the recent report that his company had been sold to the Cumberland Telephone and Telegraph Company is false.

The Syracuse, Rochester & Lake Ontario Telephone Company, to operate in Syracuse, Rochester, Oswego, Auburn, Geneva and intermediate places in New York state, has been incorporated. The capitalization is $100,000, and the directors are Sherman E. Bishop, Alvin B. Bishop, A. M. Graham, of Clyde; Jacob Strauss, Wm. Scott, C. H. Towlerton, of Lyons, and E. S. Bishop, of Rhinebeck.

A certificate of reduction of the capital stock of the Pacific Postal Telegraph-Cable Company, of New York city, from $1,000,000 to $100,000, was filed last week with the Secretary of State. The amount of the company's capital actually paid in is $1,000,000, and the liabilities are less than $5,000. Among the directors are R. V. Dey, John W. Mackay, William H. Baker, Charles R. Hosmer and A. B. Chandler.

The Bristol, Va., Telephone Company has purchased the lines of the Nolanchucky Telephone Company in East Tennessee. These lines extend to various towns and villages in Sullivan, Carter, Washington, Green and Hawkins counties, Tenn., and constitute a valuable addition to the company's lines. The Bristol company now has connection through to Morristown, 100 miles south, and will ere long have connection with Roanoke on the east by a special arrangement with the Virginia & Tennessee Telephone Company at Pulaski.

The Gainesboro, Tenn., Telephone Company have let the contract for the extension of their line from Crossville to Whitwell, a distance of 66 miles, to be completed within 60 days. They are also arranging to put in an exchange at Crossville. The Gainesboro exchange is giving excellent satisfaction. This line now gives connection with Nashville, Chattanooga and Knoxville, as well as all the neighboring towns, and gives an excellent service.

Articles of incorporation have been filed for a new American District Telegraph Company, with the local officers of the Western Union Telegraph Company as incorporators. The name of the new company is the American District Telegraph Company of Minneapolis. The incorporators are I. McMichael, J. Levin, J. P. Cassidy, W. A. Rudd and E. F. Young. The capital of the company is $200,000. The company is connected with the American District Telegraph Company, of New York, and is believed will establish similar services in all the large cities of the country into which the telegraph company enters. It is not expected that the local company will attempt to monopolize the business or drive the old American District Telegraph out of the field, for the incorporators think there is sufficient business for both concerns.

Owensboro Harrison Telephone Company Not Sold.

TO THE EDITOR OF ELECTRICAL REVIEW:

In the issue of the ELECTRICAL REVIEW, dated August 16, 1899, there appeared an item under the head of "Telephone News and Comment." which stated that this exchange had been sold to the Cumberland Telephone and Telegraph Company.

As such a statement is utterly without foundation in fact, we most respectfully ask that you retract the article, giving your correction such prominence as the original misstatement had.

This exchange has more subscribers than it has ever had, and has just completed over 100 miles of toll lines with contracts out for 50 miles of additional lines.

Owensboro Harrison Telephone Co.,
T. A. PEDLEY, Manager.
Owensboro, Ky., August 19.

OUR CANADIAN LETTER.

BADDECK, N. S.—It is probable that an electric light plant will be installed here.

WROXETER, ONT.—A movement is on foot to secure the installation of an electric light plant.

ST. JOHNS, QUE.—A by-law to raise $20,000 to install an electric light plant was defeated recently.

MONTREAL, QUE.—The Montreal Street Railway Company have decided to equip their cars with fenders.

OTTAWA, ONT.—It is again stated that the Ottawa Electric Railway Company will build a line to Rockliffe Ranges.

RAT PORTAGE, ONT.—A new company, promoted by D. C. Cameron, has made a proposition to the town for street lighting.

VICTORIA, B. C.—The electric light station will be enlarged and an additional plant put in, under the supervision of Engineer C. H. Topp.

MONTREAL, QUE.—The Montreal Street Railway have purchased the right of way, with a view to building a line round the mountain to Westmount.

KINGSTON, ONT.—The Kingston Electric Railway Company next Winter will erect at Lake Ontario park, a pavilion capable of seating 1,500 persons.

WATERLOO, ONT.—J. Stewart Clark has written to the Council regarding the proposed construction of an electric railway between Waterloo and Port Colborne.

SHAWVILLE, QUE.—Robert Surtees, civil engineer of Ottawa, has estimated that the cost of a waterworks system for this town at $11,000 and an electric light plant at $4,000.

RENFREW, ONT.—The Renfrew Electric Light and Power Company is being organized, with capital stock of $50,000. The company propose to develop the water-power of the Bonnechere River.

HALIFAX, N. S.—F. A. Huntress, manager of the Halifax Tramway Company, has returned from a trip to the West Indies where he was looking over the field, with a view to securing street railway franchises.

ALMONTE, ONT.—A by-law to raise $30,000 by debentures for the purpose of installing a civic electric light plant, has been given its second reading in Council. The ratepayers will vote on the question on September 25.

ORILLIA, ONT.—The Engineering Contract Company, of New York, through its Canadian agency, have been fighting on the proposed power transmission scheme, with a view of taking over the contract abandoned by the Central Construction Company.

ARMPRIOR, ONT.—R. Anderson, of Ottawa, has submitted to the Council a proposition to establish an electric light plant, building a power house at Galletta, and it is expected that he will be given the contract and commence work on his proposition at once.

QUEBEC, QUE.—The British American Pulp and Paper Company, composed of R. Prefontaine, of Montreal; Jules Tessier, of this city, and others, propose constructing an electric railway from a point on the Lake St. John Railway, round the lake to Roberval, with branch lines.

HAMILTON, ONT.—The Cataract Power Company have taken over the Hamilton & Dundas Railway, and will likely commence at an early date the construction of a line to Guelph. The company also contemplate the construction of the Hamilton, Ancaster & Brantford Railway.

WOODSTOCK, ONT.—Dr. S. Litter Ickes, of the firm Ickes & Armstrong, street railway promoters, Harrisburg, Pa., was again in this city last week in connection with the project to construct an electric railway, connecting Woodstock with the neighboring towns. It is expected that the first line will be built to Hickson and Embro. J. A. C.

Montreal, August 19.

The U.S. Cable Steamer "Hooker" Badly Damaged.

The United States cable ship "Hooker," which was described in the ELECTRICAL REVIEW of April 26, 1899, went ashore on a reef in the northern passage of Corregidor Harbor, in Manila Bay, and is still fast and is discharging her stores, in an effort to lighten her.

The combined efforts of the gunboat "Yorktown," the cruiser "Baltimore" and a number of tugs to float her have thus far been fruitless.

The former Spanish gunboat "España" is also assisting in the work, but up to the last telegraphic advices their efforts had been unsuccessful. The "Hooker" is said to be badly damaged and her hold is full of water.

Some Business Aspects of Electric Traction.

The profitable radius of action of local transportation systems is limited by the time factor to an hour and a half between the inner business zone of a city and its outer residence zone, and in the case of horse cars this time limit implies a distance of nine miles, says Mr. W. J. Clark in *Cassier's Magazine*. It must be noted that the area of the inner or business zone may vary within very wide limits, as we may see clearly in the case of London, where the tram cars are replaced by omnibuses over a central area of about nine square miles, thus marking off what would be called, in the case of any other city, the strictly urban from the suburban districts.

If we now turn to the modern electric trolley car, we can see at once how its profitable radius of action has been extended within our time limit of one hour and a half. Its speed is no longer controlled by the consideration of wear and tear on horses, and there is practically an inexhaustible supply of propulsive power. Nearly all trolley cars now in service weigh at least 20,000 pounds empty, or, with 60 seated passengers, over 30,000 pounds. These cars, equipped with two motors, make an average speed of from 8 to 10 miles an hour in streets not crowded with vehicular traffic, and a speed of 15 to 18 miles an hour in comparatively unimpeded suburban thoroughfares. In an hour and a half these cars will run a distance of 18 miles, or double the speed of a horse car. But, doubling the diameter gives us four times the area, so that if we substitute trolley cars for horse cars on any system, preserving the same time limit as before and extending the tracts to meet the new conditions, we shall give the same accommodation to four times as many people.

Other important consequences follow from raising the limit of speed and increasing the amount of propulsive power which can be applied to each car. Larger and more comfortable cars can be more easily massed to catch the tide of travel, as it flows inwards in the morning and outwards in the afternoon. Trolley cars travel fast enough to produce a feeling of mental exhilaration, which is absent from, or scarcely felt by, passengers in horse cars. The result is that trolley cars attract a far larger amount of what may be called optional patronage than ever horse cars could have done.

The large trolley car, with its fine upholstery and smooth riding, and with its cheap fares for comparatively long distances, offers positive inducements to those to travel who might otherwise stay at home, and more persons go shopping or visiting, or to theaters or places of recreation. We see the best example of this optional patronage in the free use of the open cars throughout the hot Summers in the United States, when mothers take their young children to catch the cool breeze made by the motion of the car, and persons of all ages and both sexes enjoy trolley rides almost as much as they would sleigh rides in the Winter.

It follows, therefore, that the increase in gross receipts of trolley cars over horse cars is accounted for chiefly under two general heads; first, by the increase in the contributory area of population within the same time limit; and, secondly, by the increased facilities and inducements offered to optional travelers.

A New American Type of Electromobile Brougham.

A New American Electromobile.

Notwithstanding the greater interest and activity in electromobile circles abroad, some of the new American types of these vehicles are representative of the most advanced engineering and æsthetic design. The brougham illustrated herewith is, primarily, a vehicle for private use, and is marked by great beauty of proportion as well as by careful attention to structural details.

The brougham is provided with solid rubber tires on both front and rear wheels, the former being 36 inches in diameter, and the latter 42 inches. The wheel base is only 80 inches, sufficient to assure stability, yet permitting the vehicle to be turned or handled in a very narrow space. The tread is 59 inches, or a little more than the standard, making the vehicle very stable laterally.

Steering is accomplished by the forward wheels, the two motors being geared to the rear wheels. These motors are of two kilowatts capacity each, and give the vehicle a speed of 10 miles per hour as a maximum. The controller is arranged for three speeds ahead and one backwards.

The accumulators are carried in the box over the rear axle and also under the driver's seat. Their capacity is sufficient to operate the vehicle over 25 miles of level macadam road on one charge. Electric side lights, operated from the battery, are provided, as well as an alarm gong under the forward part of the brougham. A combination voltmeter and ammeter on the dashboard shows the driver at a glance the condition of the battery.

The vehicle seats two passengers in addition to the driver and footman, and weighs, complete, 4,000 pounds. It is made by the Riker Electric Vehicle Company, Brooklyn, N. Y., which is largely extending its works for the manufacture of electromobiles.

Further Data Wanted.

Reporter—"The name of that man on the West Side who was struck by lightning is Brzinslatowskiwicz."

Assistant City Editor—"What was his name before he was struck by lightning?"—*Chicago Tribune.*

The Ward Electric Supply and Construction Company, of 133 William street, New York city, has made an assignment to Isaac W. Ullman.

The La Bella Mill Water and Power Company's Plant.

One of the most important recent additions to the mining plants in the Cripple Creek district in Colorado is the new power plant of the La Bella Mill Water and Power Company, which was opened officially on August 19. The plant is situated in Goldfield, and adds to that little city the most imposing building in the district, for the structure is built entirely of masonry and steel, is fireproof throughout, and is very complete in its appointments. The building covers a space of about 10,000 square feet, while the roof ridge is some 50 feet above the ground. Close to the building stands the steel stack, 210 feet high from the bottom of the flue, the steel portion standing 190 feet above the masonry, with a capping 12 feet in diameter. Though built of steel, the stack is wholly self-supporting, and there are no guy wires or rods to detract from its slender appearance. The massive foundations alone give the power to resist the heavy winds which are so prevalent at these mountain altitudes.

The La Bella plant will be used to operate the Florence & Cripple Creek and Golden Circle railroads in the district and to supply power, water and light to the mines, mills, samplers, etc., near by. The machinery for these manifold purposes must needs be complete, and in this case no expense has been spared to procure the best obtainable. In the installation of the machinery many novel features are to be found, and these will contribute in no small way to the efficiency and the economy of operation.

In the boiler-room are six large boilers of the Babcock & Wilcox type, arranged in three batteries. These boilers are capable of supplying the engines with steam for 3,000 horse-power, under normal conditions, and, should the service require, they can deliver steam for 4,500 horse-power. These boilers are arranged in a novel manner, for instead of being constructed directly upon masonry foundations, as would ordinarily be done, they are mounted on elevated steel beams and a space is thus left underneath all the boilers. Instead of carrying the smoke and gases to the stack over the boilers, in the usual way, they are carried downward into this basement space left beneath the boilers and thus taken to the stack. The space above the boilers is thus left perfectly clear and nothing is visible in the boiler-room

to indicate the presence of a flue. The heat and the obstruction of the large flue is thus done away with in the boiler-room, while the space above the boilers is entirely clear for the steam-pipes and valves, and these are readily accessible. A further use is made of the basement under the boilers in the handling of ashes. Instead of drawing the ashes from the fires into the boiler-room, they are dropped into the basement to an ash conveyer and are carried directly to the cars on the track on the outside of the building. The coal for the plant is likewise handled automatically, and without the usual dust and dirt in the boiler-room. The coal is dumped from cars on an elevated track directly into the steel coal-bins. These bins are inverted pyramids supported from the roof, the coal being dumped through the roof into the bins. From the bins the coal falls into a weighing device, which in turn drops the coal to the automatic stokers, all the feeding of the coal being accomplished by gravity. The stokers are of the Babcock & Wilcox type, having an endless chain grate. After the reception of the coal from the bins it is fed to the fires as the service may require it, and the ashes are carried on and dumped into the basement conveyer. Neither coal nor ashes are handled in the boiler-room, which is, therefore, perfectly clear and free from all dirt. An interesting feature of the automatic stokers is that one attendant takes care of the six large boilers even when the plant is carrying the heaviest load.

Next to the boiler-room is the pump-room, and in addition to the pumps for supplying the plant's requirements, provision has been made for furnishing water to the railroads, mines, mills and other consumers. Underneath the pump-room is a deep basement in which is located the economizer. Next the economizer-room is a well appointed bath and toilet-room for the use of employés.

Extending the full length of the building, and adjoining both the boiler-room and pump-room, is the engine-room; this room is 110 feet long and 45 feet wide and contains a large compressor and three large engines, driving dynamos. The combined engine capacity is 3,000 horse-power. Over the entire engine-room is a powerful traveling crane, capable of lifting any piece of machinery in the plant; by a novel design this crane is made to extend out of the building and overhang the railroad track and wagon road, so that any piece of machinery is readily transferred to any portion of the engine-room. One of the conspicuous features of the engine room is the large air compressor. This is of the Ingersoll–Sargent make and is driven by an Allis–Corliss engine. The compressing cylinders and the steam cylinders are both compound and the steam cylinders are condensing. The high-pressure air cylinder has a diameter of 22 inches, while the low-pressure cylinder has a diameter of 40 inches, both having a stroke of 48 inches. The capacity of the compressor being some 5,000 feet of free air per minute, 50 drills could ordinarily be operated, and even at this high altitude of 10,000 feet above sea level, 35 drills can be operated. This compressor supplies air directly to a large number of producing mines; in one direction a pipe line to the Victor mine extends a mile, while a mile in the opposite direction is the Granite mine, also supplied through a pipe line. There are also pipe lines to the Golden Cycle, Gold Knob and other properties. The output from the drills operated by this compressor will therefore exceed 1,000 tons per day.

Adjoining the compressor are the large engines coupled to the dynamos. The electric power will be used to operate the Florence & Cripple Creek Railroad, from Alta Vista to Cripple Creek, and the Golden Circle Railroad, from Victor to Cripple Creek via Vista Grande. The surplus power will be used to operate the hoists, pumps, compressors, crushers, etc., in mines, mills, samplers, etc., throughout the district. The engines are of the horizontal type and are compound condensing. The normal capacity of each engine is 750 horse-power; they are, however, capable of supplying 1,100 horse-power each when occasion demands. The engines were built by the McIntosh–Seymour Company, of Auburn, N. Y. The main shaft of the engines carries the electric generators, this shaft being 16 inches in diameter. The arrangement of each engine is such that part of the engine can be operated while the other part is being cleaned or repaired; that is, the engine is practically a double unit, which may be subdivided. The cylinders of these engines are 18 inches in diameter for the high pressure and 40 inches in diameter for the low pressure. The generators were built by the General Electric Company. They are of the latest type and generate three-phase alternating current, at 60 cycles. The pressure is 6,600 volts, this being carried directly on the generator, and reduced to 440 volts by a transformer wherever used. There are many novel features in connection with the engines and among the number is the oiling arrangement. When an engine is started the oil is automatically turned on and immediately flows to all parts of the engine requiring lubrication. Thus the service of attendants is not required for this and, in addition to this saving of labor, all oil is caught in receptacles and automatically returned through filters to the supply tanks to be used over again, and very little oil is wasted. The capacity of each unit of engine and generator is 1,100 horse-power. The guarantees of economy made on these engines and generators are said to have been the highest ever made.

The steam piping also exhibits many unusual features of design, for it is so arranged that any pipe can be removed for repairs, or any part shut off for inspection, without disturbing the operation of the plant. The engines are located within 10 feet of the boilers and the piping required is therefore very short, so the losses of heat are reduced to a minimum. The exhaust piping is likewise very short, offering very slight resistance to the outlet from the engines to the condenser. The condenser is of the elevated siphon type, and has the peculiarity of separating the air from the water and pumping each separately. The fact that condensing machinery is used is of itself one of the novelties of the plant. It is usually the custom to use condensing machinery only where there is an abundant supply of water, as the amount of water required for condensing is from 25 to 30 times that required for non-condensing. In the La Bella plant the water is used over and over again, and is cooled between each successive use. For the purpose of cooling the water there is erected a large cooling tower. The water is then returned to the condenser. This cooling tower is 110 feet long, 20 feet wide and 20 feet high, and is mounted on an elevated piece of ground near the building. Owing to its elevated position the top of the cooling tower is about 40 feet above the engine-room floor. Water is pumped to the top of this tower and allowed to fall by gravity, and on the way it loses heat by contact with the air. By the use of the cooling tower and the economical machinery, condensing permits 50 per cent of the coal to be saved.

With the automatic coal feeding and handling of coal, the continuous cooling of the water, the automatic oiling, the abstracting of heat from the smoke and gases, together with the high class of machinery and its economical arrangement, the La Bella company's plant represents the most advanced state of power-house designing, and is one of the most complete and economical stations in the world.

The complicated problems, which the utilization of energy in these manifold forms presented, necessitated the employment of a special staff of engineers. Mr. L. L. Summers was retained as consulting engineer and the designs were prepared and the work executed under his immediate supervision.

INDUSTRIAL NEWS.

Mr. A. O. Schoonmaker, the well known mica manufacturer, of 158 William street, New York city, states that his name has been used by the "mica trust" without authority and that he has no connection whatever with it.

The Babcock & Wilcox Company is reported to be negotiating for a $300,000 tract of land near Bayonne, N. J., on which fireproof buildings, costing over $1,000,000, will be erected. The new plant will employ more than 1,000 men.

Individuality is a part of success. It follows in advertising as in more subdued business methods. The Central Electric Company, Chicago, has decided to have something additionally distinctive of the firm appear in all its "ads.," hence its firm signature will be in its own form of "old English" type. Inasmuch as this firm's advertising is strictly as facts exist, this peculiar form of type will permit discriminating and busy buyers to easily find the "Central's" announcements and learn of such electrical material as is thoroughly reliable and up to date, with the certainty of the promptest shipments.

The Joseph Dixon Crucible Company, Jersey City, N. J., have issued a catalogue entitled "Dixon's Graphite Productions," contained in a cover lithographed in colors. The cover stock has a rough surface resembling canvas in texture, and the color work is equal if not superior to the best French productions of this character. The various products of the Dixon plant are clearly illustrated and concisely and intelligibly described. Besides a solid belt dressing the Dixon specialties here enumerated include boxes of standard or special sizes for baking carbons, lamp filaments, etc.; ground graphite in any degree of fineness, graphite resistance rods and devices up to two inches diameter and 12 inches length, varying in resistance from one ohm to 1,000,000 ohms, and graphite for lamp cement and battery plates. The catalogue collection of an electrical manufacturer is incomplete without the new Dixon catalogue.

An Irish Conductor Stops a Trolley Car.

[*From the Mechanical Engineer.*]

A rather extraordinary accident occurred on Sunday last on one of the Dublin electric tram cars, which rather suggests the desirability of some safety device to prevent the inadvertent or accidental use of the cord attached to the trolley pole by passengers or other unauthorized persons. It seems a passenger who was on the top of the car was desirous of alighting, and asked the conductor to stop. The latter, who was busy collecting the fares, requested the passenger to pull the bell-cord, but he in error pulled the rope attached to the trolley pole, and apparently did it in so clumsy a manner that it became displaced and struck the guard wires, breaking them and causing the broken ends to fall among the passengers on the top of the car. Owing to these wires making contact with the conductor three of the passengers suffered an extremely serious shock, being rendered unconscious for several hours, and necessitating their being conveyed to the hospital. The passenger who unwittingly brought about the occurrence was hauled before the magistrate on the charge of unlawfully interfering with the wires, but the charge was dismissed by the magistrate on the ground that the tramway company were to blame in not having a man constantly in charge of the trolley ropes. The occurrence goes to show how easily a serious mishap may be brought about, and the point is one to which electrical car companies would do well to pay some attention, with a view to preventing any accidental repetition of such an occurrence as the one under notice.

The American Electrical Works' Clambake.

Invitations have been issued for the twenty-first annual Rhode Island clam dinner tendered to the electrical fraternity by Mr. Eugene F. Phillips, general manager of the American Electrical Works, of Providence, R. I. The dinner will be given at the Pomham Club, on Saturday, September 9, at two o'clock in the afternoon. A luncheon will be served at 11.30 A. M.

Mr. Phillips is noted for doing nice things in unusual ways. He cleverly illustrates the prosperity of the American Electrical Works, and his disdain of the precious metals by printing his invitations on sheets of copper four by six inches in size. With copper as high and as scarce as it is now, this looks like reckless extravagance. The ELECTRICAL REVIEW warns the fraternity at large that it would not be *recherché* for the invited guests to attempt to sell their invitations to Mr. Phillips for scrap copper.

Candle Gas-Burner Lighting Attachments.

The gas-burners made to represent candles are peculiarly difficult to ignite by electrical devices on account of their construction and the absence of any standard pattern in them. They consist, generally, of a central brass tube, carrying the burner tip at its top, and the outer candle-shaped porcelain sheath which slips over it. In the narrow space between the two must be mounted the electric-igniting device, and this must be so arranged as to permit the easy removal of the porcelain "candle."

The four figures herewith show the method employed by the A. L. Bogart Company, New York, for fitting these burners with electric igniters. Fig. 1 shows the inner tube and igniter mechanism, while Fig. 2 shows the completed burner. Figs. 3 and 4 are candle-burners, using the same form of inner stem, but having stop-cocks actuated by a stiff wire and a ratchet,

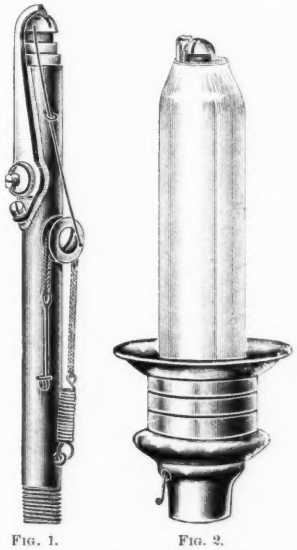


FIG. 1. FIG. 2. FIG. 3. FIG. 4.

ELECTRIC GAS-LIGHTING ATTACHMENTS FOR CANDLE-BURNERS.

working to shut off or turn on the gas by alternate pulls on a chain. The operation of the igniter is so clearly shown in Fig. 1 as to make description superfluous.

The town of Ludlow, Vt., is about to build a municipal street lighting plant, not to exceed $30,000 in cost. Geo. H. Levy, Fred O. Knight and L. G. Fullman have been appointed a committee to have charge of the work.

An Improved Cable Clip.

The "Holdfast" cable clip illustrated herewith is quickly and easily applied by hand. It can be removed from time to time for new work as may be desirable without destroying its efficiency. The metal strap is simply drawn around the cable and passed through the hanger, the part with the hooks is then turned up, as shown in the illustration, which

AN IMPROVED CABLE CLIP.

action takes up the slack, binds the strap tightly about the cable and prevents the latter from slipping. All parts are carefully made and of the best material; being made of galvanized steel and zinc, they will not rust or, it is claimed, in any way injure the cable. This improved cable clip is now being used very extensively by the principal telephone companies, and already there are many hundred thousands in this country. The manufacturers of this handy device are James S. Barron & Company, 24 Hudson street, New York city.

BOOK REVIEW.

"A Practical Course in Mechanical Drawing." By William Fox and Charles W. Thomas. D. Van Nostrand Company. New York. 1899. Cloth, 12mo., 100 pages, 87 illustrations, $1.25. Sent prepaid on receipt of price by the Electrical Review Publishing Company, 41 Park Row, New York city.

This is a good, practical book, intended to instruct people in the art of mechanical drawing in the easiest and most simple way. The illustrations are clear and to the purpose, and the little book is one that will be found of real value to the beginner in shop drawing.

THE WAVE THEORY OF LIGHT—ITS INFLUENCE ON MODERN PHYSICS.

BY A. CORNU.

(*Concluded from page 106.*)

Optics is really a modern science. The ancient philosophers had no idea of the complexity of what is vulgarly called light; they confounded in the same name what is proper to man, and what is exterior. They had, however, perceived one of the characteristic properties of the link, which exists between the source of light and the eye, which receives the impression, "Light moves in a straight line." Common experience had revealed this axiom through the observation of the shining trains that the sun throws across the skies, piercing misty clouds, or penetrating into some dark space. Hence arises two empirical notions—the definition of the ray of light, and that of the straight line. The one became the basis of optics, the other that of geometry.

Very little remains to us of the ancient books upon optics. Yet we are aware that they knew the reflection of the luminous rays on polished surfaces, and the geometrical explanation of the images formed by mirrors.

We must wait many centuries until the scientific revival for a new progress in optics (but then a very considerable one) opens the new era; it is the invention of the telescope.

The new era begins with Galileo, Boyle and Descartes, the founders of experimental philosophy. All devote their life to meditations on light, colors and forces. Galileo lays the base of mechanics, and, with the refracting telescope, that of astrophysics. Boyle improves experimentation. As to Descartes, he embraces with his penetrating mind the whole of natural philosophy; he throws away the occult causes admitted by the scholastics, and proclaims as a principle that all phenomena are governed by the laws of mechanics. In his system of the universe, light plays a prominent part*; it is produced by the waves excited in the subtle matter which, according to his view, pervades space. This subtle matter (which represents what we call to-day the ether) is considered by him as formed of particles in immediate contact; it constitutes thus, at the same time, the vehicle of the forces existing between the material bodies which are plunged in it. We recognize the famous "vortices of Descartes," sometimes admired,

* Le Monde de M. Descartes, ou le Traité de la Lumière (Paris, 1664).

sometimes baffled during the last centuries, but to which skillful contemporaneous physicists have rendered the importance they deserve.

Whatever may be the opinions granted to the exactness of the deductions of this great philosopher, we must be struck by the boldness with which he proclaims the connection of the great cosmical problems, and fortells the solutions which actual generations did not yet entirely accept, but drew insensibly to.

In Descartes's view the mechanism of light and that of gravitation are inseparable; the seat of corresponding phenomena is this subtle matter which pervades the universe, and their propagation is performed by waves around the acting centers.

This conception of the nature of light shocked the opinions in vogue; it raised strong opposition. Since the oldest times it was the habit to imagine the luminous ray as the trajectory of rapid projectiles thrown by the radiant source. Their shock on the nerves of the eye produce vision: their resistance or changes of speed, reflection or refraction. The Cartesian theory had, however, some seductive aspects which brought defenders. The waves excited on the surface of still water offer so clear an image of a propagated motion around a disturbing center! On the other hand, do not the sonorous impressions reach our ear by waves? Our mind feels yet a real satisfaction in thinking that our most sharp and delicate organs are both impressed by a mechanism of the same nature.

Yet a serious difference arose. Sound does not necessarily travel in straight lines as light does. It travels round any object opposed to it, and will follow the most circuitous routes with scarce'y any loss of strength. Physicists were thus divided into two camps. In one the partisans of emission, in the other those of the wave theory, each system boasting itself superior, and indeed each being so in certain respects. Other phenomena had to be examined in order to decide between them.

The chance of discovery brought to view several phenomena which ought to have decided in favor of wave theory, as was proved a century later; but the simplest truth does not prevail without long endeavor.

A strange compromise was effected between the two systems, helped on by a name great among the greatest, and for a century the theory of emission triumphed.

The tale is a strange one. In 1661 a young scholar, full of eagerness and penetration, enters Trinity College, Cambridge; his name is Isaac Newton. He has already in his village read Kepler's "Optics." Almost immediately, and while following Barrow's lectures upon optics, he studies the geometry of Descartes with passionate care; with his savings he buys a prism that he might examine the properties of color and meditate deeply on the causes of gravitation. Eight years later his masters think him worthy to succeed Barrow in the Lucasian professorship, and in his turn he also teaches optics. The pupil soon becomes greater than his teacher, and he gives out this great result: White light, which seemed the type of pure light, is not homogeneous; it consists of rays of different refrangibility, and he demonstrates it by the celebrated experiment of the solar spectrum, in which a ray of white light is decomposed into a series of colored rays like a rainbow; each shade of the color is simple, for the prism does not decompose the shade. This is the origin of the spectral analysis. This analysis of white light brought Newton to explain the colors of the thin plates which are, for instance, observed in soap-bubbles. The fundamental experiment, that of Newton's rings, is one of the most instructive in optics, while the laws that govern it are of admirable simplicity.

The theory was expounded in a discourse addressed to the Royal Society, with the title "A New Hypothesis Concerning Light and Color."

This discourse called forth from Hooke a sharp complaint. Hooke also had already examined the color of thin plates, and endeavored to explain them in the wave system. He had the merit, which Newton himself readily granted, to substitute for the progressive wave of Descartes a vibrating one, a new and extremely important notion. He had even noticed the part of the two reflecting surfaces of the thin plate, and the mutual action of the reflected waves. Consequently, Hooke should have been the very forerunner of the modern theory if he had had, as Newton, the clear intelligence of the simple rays. But his vague reasoning to explain the colors takes away all demonstrative value from his theory.

Newton is very affected by this complaint of priority, and combats the arguments of his adversary by remarking that the wave theory is inadmissible because it does not explain the existence of the luminous ray and of the shadows. He denies the opinion that he has raised a theory; he certifies that he does not admit either the wave hypothesis or the emission, but he says "He shall sometimes, to avoid circumlocution and to represent it conveniently, speak of it as if he assumed it and propounded it to be believed." And, really, in the Proposition XII (second book of his "Optics"), which constitutes what was since called the theory of fits, Newton remains absolutely on the ground of facts. He says simply, the phenomena of thin plates prove that the luminous ray is put alternatively in a certain state or fit of easy reflection and of easy transmission. He adds, however, that if an explanation of these alternative states is required they can be attributed to the vibrations excited by the shock of the corpuscles, and propagated under the form of a wave in ether.

After all, notwithstanding his desire to remain on the firm ground of facts, Newton can not help trying a rational explanation. He has too carefully read the writings of Descartes not to be heartily, as Huygens, a partisan of the universal mechanism and not to wish secretly to find in the pure undulations the explanation of the beautiful phenomena he has reduced to such simple laws. But his third book on optics more especially proves his Cartesian aspirations, and, above all, his perplexity. His famous "Queries" expose so forcibly his argument in favor of the wave theory of light that Thos. Young will later cite them as proof of the final conversion of Newton to the wave theory. Newton would certainly have yielded to this secret inclination had the inflexible logic of his mind allowed him to do so; but when after enumerating the arguments the wave theory of light offers in explanation of the intimate nature of light, when he arrived at the last "Queries" he stops, as if seized by a sudden remorse, and throws it away. And the sole argument is that he does not see the possibility of explaining the rectilinear transmission of light. Viewed from this standpoint the third book of "Optics" is no longer only an impartial discussion of opposite systems; it appears as the painting of the suffering of a mighty genius, worried by doubt, now led away by the seductive suggestions of his imagination, now recalled by the imperious requirements of logic. It is a drama; the everlasting struggle between love and duty; and duty won.

Such, I take it, is the inner genesis of the theory of fits—a strange mingling of two opposite systems. It was much admired, presented, as it was, by the great mathematician, who had the glory of submitting the motions of all celestial bodies to the one law of universal gravitation.

To-day this theory is abandoned; it is condemned by the *experimentum crucis* of Arago, realized by Fizeau and Foucault. One ought, however, to acknowledge that it has constituted a real progress by the precise and new notions which it contains. The ray of light, considered up till then, was simply the trajectory of a particle in rectilinear motion; the ray of light, such as Newton described it, possesses a regular periodic structure, and the period or interval of fits, characterizes the color of the ray. This is an important result. It only requires a more suitable interpretation to transform the luminous ray into a vibratory wave; but we had to wait a century, and Dr. Thomas Young, in 1801, had the honor of discovering it.

Resuming the study of thin plates, Thomas Young shows that everything is explained with extreme simplicity, if it be supposed that the homogeneous luminous ray is analogous to the sonorous wave produced by a musical sound; that the vibrations of ether ought to compose—that is to say, to interfere—according to the expression that he proposes as to their mutual actions.

Although Young had taken the clever precaution of supporting his views by the authority of Newton, the hypothesis found no favor; his principle of interference led to this singular result that light added to light could, in certain cases, produce darkness, a paradoxical result contradicted by daily experience. The only verification that Young brought forward was the existence of dark rings in Newton's experiment, darkness due, according to him, to the interference of waves reflected on the two faces of the plate. But as the Newtonian theory interpreted the fact in a different manner, the proof remained doubtful; an *experimentum crucis* was wanting. Young did not have the good success to obtain it.

The theory of waves relapsed then once more into the obscurity of controversy, and the terrible argument of the rectilinear propagation was raised afresh against it. The most skilled geometers of the period—Laplace, Biot, Poisson — naturally leaned to the Newtonian opinion; Laplace in particular, the celebrated author of the "Mecanique Celeste," had even taken the offensive. He was going to attack the theory of waves in its most strongly fortified entrenchments, which had been raised by the illustrious Huygens.

Huygens, indeed, in his "Traité de la Lumière," had resolved a problem before which the theory of emission had remained mute; that is to say, the explanation of the double refraction of Iceland spar; the wave theory, on the contrary, reduced to the simplest geometrical construction the path of the two rays, ordinary and extraordinary; experiment confirmed the results in every point. Laplace succeeded in his turn (with the help of hypotheses of the constitution of luminous particles) to explain the path of these strange rays. The victory of the theory of particles then appeared complete; a new phenomenon arrived also appropriately to render it striking.

Malus discovered that a common ray of light reflected under a certain angle acquired unsymmetrical properties similar to those rays from a crystal of Iceland spar. He explained this phenomenon by an orientation of the luminous molecule, and, consequently, named this light polarized light. This was a new success for emission.

The triumph was not of long duration. In 1816 a young engineer, scarcely out of the Ecole Polytechnique, Augustin Fresnel, confided to Arago his doubts on the theory then in favor, and pointed out to him the experiments which tended to overthrow it.

Supporting himself on the ideas of Huygens, he attacked the formidable question of rays and shadows, and had resolved it; all the phenomena of diffraction were reduced to an analytical problem, and observations verified calculation marvelously. He had, without knowing it, rediscovered Young's reasonings as well as the principle of interference; but more fortunate than he, he brought the *experimentum crucis*—the two-mirror experiment; there, two rays, issuing from the same source, free from any disturbance, produced when they met,

sometimes light, sometimes darkness. The illustrious Young was the first to applaud the success of his young rival, and showed him a kindness which never changed.

Thus, thanks to the use of two-mirror experiment, the theory of Dr. Young (that is to say, the complete analogy of the luminous ray and the sound wave) is firmly established.

Moreover, Fresnel's theory of diffraction shows the cause of their dissimilarity; light is propagated in straight lines because the luminous waves are extremely small. On the contrary, sound is diffused because the lengths of the sonorous waves are relatively very great.

Thus vanished the terrible objection which had so much tormented the mind of great Newton.

But there remained still to explain another essential difference between the luminous wave and the sonorous wave; the latter undergoes no polarization. Why is the luminous wave polarized?

The answer to this question appeared so difficult that Young declared he would renounce seeking it. Fresnel worked more than five years to discover it; the answer is as simple as unexpected. The sound wave can not be polarized because the vibrations are longitudinal; light, on the other hand, can be polarized because the vibrations are transverse; that is to say, perpendicular to the luminous ray.

Henceforth the nature of light is completely established, all the phenomena presented as objections to the undulatory theory are explained with marvelous facility, even down to the smallest details.

I would fain have traced by what an admirable suite of experiment and reasoning Fresnel arrived at this discovery, one of the most important of modern science; but time presses.

It has sufficed me to explain how very great the difficulties were which he had to overcome in order to establish it.

I hasten to point out its consequences.

You saw, at starting, the purely physiological reasons which make the study of light the necessary center of information gathered by human intelligence. You judge now, by the march of this long development of optical theories, what preoccupations it has always caused to powerful minds interested in natural forces. Indeed, all the phenomena which pass before our eyes involve a transmission to a distance of force or movement; let the distance be infinitely great, as in celestial space, or infinitely small, as in molecular intervals, the mystery is the same. But light is the agent which brings us the movement of luminous bodies; to fathom the mechanism of this transmission is to fathom that of all others, and Descartes had the admirable intuition of this when he comprehended all these problems in a single mechanical conception—here is the secret bond which has always attracted the physicists and geometers towards the study of light. Looked at from this point of view, the history of optics acquires a considerable philosophical importance; it becomes the history of the successive progress of our knowledge on the means that nature employs to transmit movement and force to a distance.

The first idea which came to the mind of man (in the savage state) to exercise his force beyond his reach is the throwing of a stone, of an arrow or of some projectile; this is the germ of the theory of emission. This theory corresponds to a philosophical system which assumes an empty space in which the projectile moves freely. At a more advanced degree of culture, man having become a physicist, has had the more delicate idea of the transmission of movement by waves, suggested at first by the study of waves, afterwards by that of sound.

This second way supposes, on the other hand, that space is a plenum; there is no longer here transport of matter; particles oscillate in the direction of propagation, and it is by compression or rarefaction of a continuous elastic medium that movement and force are transmitted. Such has been the origin of the theory of luminous waves; under this form it could only represent a part of the phenomena; it was therefore insufficient.

But geometers and physicists before Fresnel did not know of any other undulatory mechanism in a continuous medium.

The great discovery of Fresnel has been to reveal a third mode of transmission quite as natural as the preceding one, but which offers an incomparable richness of resources. These are the waves of transverse vibrations excited in an incompressible continuous medium, those which explain all the properties of light.

In this undulatory mode the displacement of particles brings into play an elasticity of a special kind; this is the relative slipping of strata concentric to the disturbance which transmits the movement and the effort. The character of these waves is to impose on the medium no variation of density, as in the system of Descartes. The richness of resource mentioned above depends upon the fact that the form of the transverse vibration remains indeterminate,and thus confers on waves an infinite variety of different properties.

The rectilinear, circular and elliptical forms characterize precisely the polarizations, so unexpected, which Fresnel discovered, and by the aid of which he has so admirably explained the beautiful phenomena of Arago produced by crystallized plates.

The possible existence of waves which are propagated without change of density has profoundly modified the mathematical theory of elasticity. Geometers found again in their equations waves having transverse vibrations which were unknown to them; they learned besides, from Fresnel, the most general constitution of elastic media,of which they had not dreamed.

It is in his admirable memoir on double refraction that this great physicist set forth the idea that in crystals the elasticity of the ether ought to vary with the direction, an unexpected condition, and one of extreme importance, which has transformed the fundamental basis of molecular mechanics; the works of Cauchy and Green are the striking proofs of it From this principle Fresnel concluded the most general form of the surface of the luminous wave in crystals, and found (as a particular case) the sphere and ellipsoid that Huygens had assigned to the Iceland spar crystal. This new discovery excited universal admiration among physicists and geometers; when Arago came to expound it before the Académie des Sciences, Laplace, who had been such a long time hostile, declared himself convinced. Two years later Fresnel, unanimously elected a member of the Academy, was elected with the same unanimity foreign member of the Royal Society of London; Young himself transmitted to him the announcement of this distinction, with personal testimony of his sincere admiration.

The definite foundation of the undulatory theory imposes the necessity of admitting the existence of an elastic medium to transmit the luminous movement. But does not all transmission to a distance of movement or of force imply the same condition? To Faraday is due the honor of having, like a true disciple of Descartes and Leibnitz, proclaimed this principle,and of having resolutely attributed to reactions of surrounding media the apparent action at a distance of electrical and magnetic systems. Faraday was recompensed for his boldness by the discovery of induction.

And since induction acts even across a space void of ponderable matter, one is forced to admit that the active medium is precisely that which transmits the luminous waves, the ether.

The transmission of a movement by an elastic medium can not be instantaneous; if it is truly luminous ether that is the transmitting medium, ought not the induction to be propagated with the velocity of luminous waves?

The verification was difficult. Von Helmholtz, who tried the direct measurement of this velocity, found, as Galileo formerly, for the velocity of light a value practically infinite.

But the attention of physicists was attracted by a singular numerical coincidence. The relation between the unity of electro-static quantity to the electro-magnetic unit is represented by a number precisely equal to the velocity of light.

The illustrious Clerk Maxwell, following the ideas of Faraday, did not hesitate to see in the relationship the indirect measure of the velocity of induction, and by a series of remarkable deductions he built up this celebrated electro-magnetic theory of light, which identifies in one mechanism three groups of phenomena completely distinct in appearance, light, electricity and magnetism.

But the abstract theories of natural phenomena are nothing without the control of experiment.

The theory of Maxwell was submitted to proof, and the success surpassed all expectation. The results are too recent and too well known, especially here, for it to be necessary to insist upon them.

A young German physicist, Henry Herz, prematurely lost to science, starting from the beautiful analysis of oscillatory discharges of Von Helmholtz and Lord Kelvin, so perfectly produced electric and electro-magnetic waves, that these waves possess all the properties of luminous waves; the only distinguishing peculiarity is that their vibrations are less rapid than those of light.

It follows that one can reproduce with electric discharges the most delicate experiments of modern optics—reflection, refraction, diffraction, rectilinear, circular, elliptic polarization, etc. But I must stop, gentlemen. I feel that I have assumed too weighty a task in endeavoring to enumerate the whole wealth which waves of transverse vibrations have to-day placed in our hands.

I said at the beginning that optics appeared to me to be the directing science in modern physics.

If any doubt can have arisen in your minds, I trust this impression has been effaced to give place to a sentiment of surprise and admiration in seeing all that the study of light has brought of new ideas on the mechanism of the forces of nature.

It has insensibly restored the Cartesian conception of a single medium refilling space, the seat of electrical, magnetic and luminous phenomena; it allows us to foresee that this medium is the depository of the energy spread throughout the material world, the necessary vehicle of every force, the origin even of universal gravitation.

Such is the work accomplished by optics; it is perhaps the greatest thing of the century!

The study of the properties of waves, viewed in every aspect, is therefore, at the present moment, the most fertile study.

It is that which has been followed in the double capacity of geometer and physicist by Sir George Stokes, to whom we are about to pay so touching and deserved a homage. All his beautiful researches, both in hydro-dynamics as well as in theoretical and practical optics, relate precisely to those transformations which various media impose on waves which traverse them.

In the many phenomena which he has discovered or analyzed, movements of fluids, diffraction, interference, fluorescence, Roentgen rays, the dominant idea which I pointed out to you is always visible; it is that which makes the harmonious unity of the scientific life of Sir George Stokes.

The University of Cambridge may be proud of the Lucasian chair of mathematical physics, because from Sir Isaac Newton up to Sir George Stokes it has contributed a glorious part towards the progress of natural philosophy.

ADVANCE INFORMATION

New Telephone and Telegraph Companies.

TRENTON, N. J.—The Continental Telephone, Telegraph and Cable Company, with a capital of $1,000,000, has been incorporated. The incorporators are Henry C. Lucas, of Philadelphia; Frederick T. Ealand, of New Brighton, N. Y., and J. Herbert Potts, of Jersey City, N. J.

NORWICH, N. Y.—The Central New York Telephone Company will begin next week the construction of a new metallic circuit from this place to Oneonta, by way of Oxford and Sydney. Heretofore it has been necessary for Oneonta and Cooperstown to communicate with Norwich by way of Utica. The new system will make better connections with New Berlin and all towns adjacent to Sydney or Oneonta.

CORNISH, N. Y.—The Baldwin & Sebago Telephone Company has been incorporated to construct and operate a telephone line; capital, $10,000; incorporators, W. H. Fitch, of East Sebago; E. S. Douglass, of Sebago; L. Norton, of East Baldwin.

ALBANY, N. Y.—Articles of incorporation of the Angelica Telephone Company, of Angelica, Allegheny County, with a capital of $800, have been filed with the Secretary of State. The points to be connected from Angelica are the villages of West Almond, Birdsall and Short Tract. The directors are Fred R. and Lizzie Piatt, Lewis C. and Jennie D. Rice, Clarence L. and Josephine Lathrop, and Davis H. Richardson, of Angelica.

COLUMBUS, OHIO—The Rural Telephone Company has been incorporated to construct and operate a telephone system; capital, $10,000; incorporators, L. P. Stephens, A. F. Durant, H. W. Collins, J. Cashett, W. J. Dusenburall, of Columbus.

WOODBURY, N. J.—An extension of the telephone system from this place to Salem, by way of Bridgeport, Pennsgrove and Penneville, is talked of.

ABILENE, KAS.—The City Council has granted a telephone franchise to Brown & Son, of this city, who will put in a plant in connection with their electric light system. It is specified that the rates shall not be more than $2 a month for business houses and $1.25 for residences.

SPARTA, TENN.—Contract has been let for an extension of the Gainesboro Telephone Company's line from Crossville to Whitwell, a distance of 66 miles, to be completed within 60 days.

MEMPHIS, TENN.—The Memphis Telephone Company has been incorporated. The capital stock is fixed at $200,000. The incorporators are William P. Curtis, R. M. Warmsley, William P. Richardson, of New Orleans, and C. B. Galloway, T. K. Riddick, Bolton Smith, James S. Warren, Leon Huat, Jeptha M. Fowlkes, William A. Percy, of Memphis.

KEARNEY, NEB.—The Home Telephone Company has been incorporated to construct and operate telephone lines; capital, $15,000; incorporators, F. H. Gilcrest, J. S. Adair, J. G. Lowe.

HICO, MO.—The Hico Telephone Company has been incorporated; capital stock, $2,500; purpose, to construct and operate a telephone system; incorporators, A. F. Wilser, F. A. Wilser, J. H. Wilser.

LEXINGTON, VA.—A telephone line connecting this place and Lynchburg will be built next month.

MASSENA, N. Y.—A telephone line is to be established here.

ALBANY, N. Y.—The Granville Telephone Company has been incorporated; the capitalization is $10,000, and the general route and points to be connected are from Granville, Washington County, taking in the towns and villages in Washington, Warren and Essex Counties, and the counties of Rutland and Lennington, Vermont. The directors are Franklin T. Pember, Henry Dillingham, William H. Hughes, Emmet Wyman, Willis A. Tenney and Fred W. Hewitt, of Branville; Fred W. Allen, Anthony T. Hughes, of Middle Granville, and Frank E. Hicks, of Slyborough.

INDIANAPOLIS, IND.—The Clayton Mutual Telephone Company, of Putnam, Greene, Monroe and Brown Counties, has been incorporated with a capital stock of $10,000. The directors are L. O. Winsted, A. R. Marley, E. B. Owen, Henry Brown, R. S. Wooden, C. C. Walls, N. E. Hubbard and Marion Sinclair.

MEADVILLE, PA.—The Meadville Telephone Company has been incorporated to construct and maintain telephone lines; capital, $1,000; incorporators, W. W. Gelvin, R. E. Ashley, T. Roddy, O. Kohler, J. Hay, all of Meadville.

LOUDON, TENN.—An independent telephone line from this place to Morganton, a distance of 10 miles, will soon be completed. The People's Telephone line will be completed to Athens in a few days.

INDIANAPOLIS, IND.—The Covington & Coal Creek Co-operative Telephone Company has been incorporated, with a capital stock of $10,000. The directors are Albert P. Burnside, Elmer O. Snoddy, Albert Shaw, Charles Marlatt, Christian Penner and John Rhodes.

New Electric Railways.

TOLEDO, OHIO—The Toledo, Fostoria & Findlay Railway Company has been incorporated; capital, $100,000; incorporators, T. Wentz, S. W. Croxton, I. K. Pierson, J. W. Kinsey, E. C. Deardorff, of Toledo.

DETROIT, MICH.—The North Detroit Electric Railway Company has been incorporated, with a capital stock of $50,000.

STEUBENVILLE, OHIO—The Steubenville, Mingo & Ohio Valley Traction Company has been incorporated; capital, $150,000; incorporators, W. Lipphardt, H. S. Sands, L. G. Hallock, J. H. McKee, F. H. Eick, all of Steubenville.

SPRINGFIELD, OHIO—S. L. Nelson, who represents Philadelphia capitalists, has been granted a franchise for an electric line from this city to Hillsboro, a distance of 100 miles. The line will touch Clifton, Cedarville and Jamestown. This same syndicate is trying to secure the right of way for a road to Columbus.

LEBANON, PA.—The extension of the Lebanon Valley Street Railway Company from Annville to Palmyra is now an assured fact. The construction of the new line will be commenced next week.

ANNAPOLIS, MD.—The certificate of incorporation of the Washington, Sandy Spring & Gettysburg Railway Company has been filed for record in the executive department. The road begins at Harney, in Carroll County, and runs through Carroll, Howard and Montgomery counties to Silver Spring. The capital stock is $100,000. The incorporators are Ed C. Peter, of Montgomery County; Albert Gleason and J. Enos Ray, of Prince George's County, and George H. Harris and John B. Larner, of Washington, D. C.

AKRON, OHIO—The Doylestown Council has granted A. E. Townsend, of Cambridge, Ohio, a 25-year franchise for the construction of an electric line through the town, the road to run from Barberton, through Doylestown, to Easton. At Barberton the road is to be connected with the Akron & Cuyahoga Falls Rapid Transit line, thus giving communication with this city.

DENVER, COLO.—Burlington officials are negotiating for the purchase of the Denver, Lakewood & Golden road, a suburban line 20 miles long, owning valuable terminals in Denver and Golden, as well as a right of way for a new line through the mountains for a Salt Lake short line. The Lakewood road is now operated by electricity to the city limits and steam outside, and is in the hands of a receiver.

New Incorporations.

NEW YORK, N. Y.—The Colon Consolidated Company has been incorporated to operate electric and ice plants; capital, $30,000; incorporators, H. McCulloch, J. Machado, J. G. Peoli, M. G. Peoli, G. E. Wentworth, all of New York city.

BUFFALO, N. Y.—The New Motor Company has been incorporated to manufacture and sell steam, air, gas, gasoline and other motors, trolley bases, trolley heads and trolley wheels; capital, $25,000; directors, Samuel Wilkinson, E. L. Pixley and William M. Hoffman, of Buffalo.

DETROIT, MICH.—The Detroit Automobile Company has been incorporated; capital, $150,000.

ST. CATHARINES, ONT.—The St. Catharines Hydraulic Company, Limited, has been incorporated, with a capital of $40,000, with the object of producing and distributing electricity. Thomas R. Merritt, William Hamilton Merritt and James Hamilton Ingersoll, provisional directors.

TRENTON, N. J.—The Scott-Janney Electric Company has been incorporated in the office of the Secretary of State, with an authorized capital stock of $30,000,000, of which $15,000,000 is to be preferred stock bearing seven per cent non-cumulative dividends. Among the objects of the company, which are specified, are the construction and operation of direct and alternating-current railways and railway apparatus; the carrying of passengers and transportation of freight by land or sea; the operation of shipyards, canals, waterways, mines and factories of all kinds, and the development of electricity in any of its forms. The nominal incorporators are all employés of a corporation agency.

CLEVELAND, OHIO—The Exchange Construction Company has been incorporated to construct and operate telephone and telegraph lines; capital, $5,000; incorporators, W. G. Beck, S. H. Crowl, E. D. Foster, E. J. Rosecraus, all of Cleveland, and others.

Electric Light and Power.

PROVIDENCE, R. I.—The New England Lighting Company has been incorporated; capital, $100 000; incorporators, C. T. Daniels, C. A. Babcock, H. C. Babcock, all of this city.

ALBANY, N. Y.—The Empire State Power Company, with the principal office at Amsterdam, has been incorporated with the Secretary of State, with a capital of $1,000,000.

KNOXVILLE, TENN.—The Knoxville Electric Company has been incorporated to supply light, heat and power; capital, $1,000; incorporators, J. P. Moore, C. D. Lockwood, W. Adams, J. Moss, A. Caldwell, all of this place.

WASHINGTON, ORE.—The contract for furnishing an electric light plant for the Warm Springs Indian agency, Oregon, has been awarded to Franklin R. Anson, of Salem, Ore., at $2,948. The plant is to be in running order by October 1.

VINCENNES, IND.—The City Electric Lighting Company has been incorporated; capital, $75,000; directors, John H. Brown, George and B. O. Mayer.

Increase of Capital.

CHICAGO, ILL.—The Illinois Telephone and Telegraph Company, the new rival of the Bell company, at a stockholders' meeting, held a few days ago, voted to increase the capital stock from $2,500,000 to $5,000,000.

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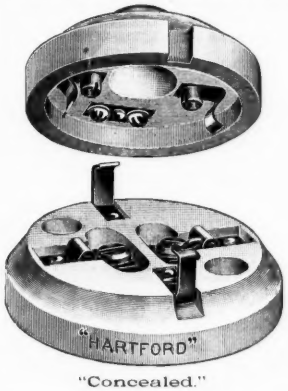

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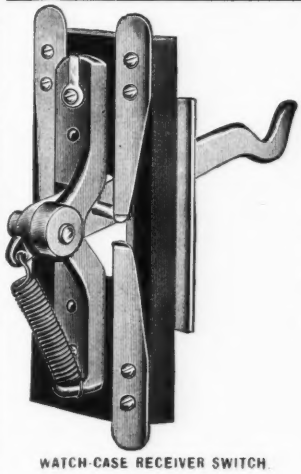

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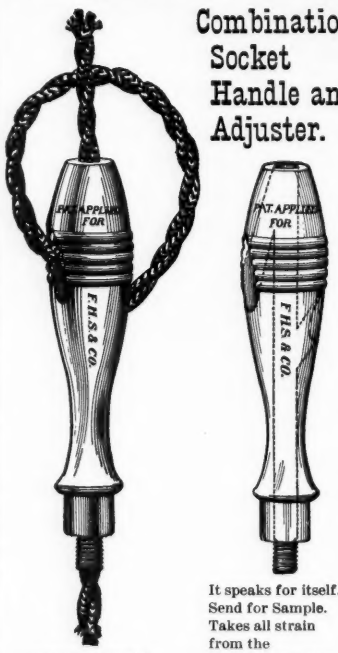

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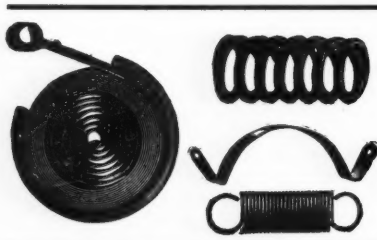

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General Electric Co.
Siemens & Halske Electric Co.
Westinghouse Electric & Mfg. Co.

Batteries, Primary.
Bunnell & Co., J. H.

Batteries, Storage.
American Battery Co.
Electric Storage Battery Co

Battery Material.
Bunnell & Co., J. H.

Bells.
Ostrander & Co., W. R.

Belt Dressing.
Dixon Crucible Co., Joseph

Boilers.
Babcock & Wilcox Co., The
Stirling Co., The

Books, Technical.
Electrical Review Pub. Co.

Braiding Machines.
New England Butt Co.

Brokers.
Faris & Thayer.
Greene, B. E.

Brushes, Dynamo.
Crown Woven Wire Brush Co.
Goldmark & Wallace.
Hobart Electric Mfg. Co.
Ohio Electric Specialty Mfg. Co.

Cable Hangers.
Standard Underground Cable Co

Cabling Machines.
New England Butt Co.

Carbon Points.
General Incandescent Arc Light Co.
National Carbon Co.

Castings.
Billings & Spencer Co.
New England Butt Co.

Circuit-Breakers.
Ward Leonard Electric Co.

Coal Mining Machinery.
General Electric Co.

Commutator Bars and Repairing.
Forest City Electric Works.

Commutator Lubricant.
Mona Manufacturing Co.
Ohio Electric Specialty Mfg. Co.

Condensers (Electric).
Marshall, Wm.

Conduits.
American Vitrified Conduit Co.
Camp Co., H. B.
Michigan Pipe Co.
National Conduit & Cable Co
Wyckoff Creosoting Co.

Connectors and Terminals.
McIntire Co., The C.

Cord Electric.
Samson Cordage Works.

Contractors.
Webster, Geo. G.

Dynamos and Motors.
Bullock Electric Mfg. Co.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Siemens & Halske Electric Co.
Warren Electric Manufacturing Co.
Westinghouse Electric & Mfg. Co.

Electric Locomotives.
General Electric Co.

Electric Novelties.
Ohio Electric Works.

Electric Heaters.
American Electrical Heater Co.

Electrical Instruments.
Bossert Electric Construction Co.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Keystone Electrical Instrument Co.
Whitney Electrical Instrument Co.

Electric Soldering Irons.
American Electrical Heater Co.

Electric Launches.
Sterling & Co., C. B.

Electrical Supplies.
Bibber-White Co.
Bunnell & Co., J. H.
Central Electric Co.
Electric Appliance Co.
Jones, J., & Son.
Novelty Electric Co.
Ohio Electric Works.
Stewart, Frank H., & Co.
Western Electric Co.

Electromobiles.
American Electric Vehicle Co.

Engineers and Contractors.
McCay Engineering Co.
New England Engineering Co.
White & Co., J. G.

Engines.
American Engine Co.
Ball & Wood Co.

Fans and Fan Motors.
Central Electric Co.
Diehl Mfg. Co.
Emerson Electric Mfg. Co.
General Electric Co.
General Incandescent Arc Light Co.
Paragon Fan & Motor Co.
Warren Electric & Specialty Co.

Fiber.
Kartavert Mfg. Co.

Fixtures, Gas and Electric.
McKenney & Waterbury.

Fuse Wire and Links.
General Electric Co.
McIntire Co., The C.

Globes, Shades, Etc.
Frink, I. P.
Phœnix Glass Co.

Graphite.
Dixon Crucible Co., Jos.

House Goods.
Central Electric Co.
Ostrander & Co., W. R.

Instruments (Testing and Recording.)
Bristol Co., The
General Electric Co.
General Incandescent Arc Light Co.
Machado & Roller.
Keystone Electrical Instrument Co.
Westinghouse Electric & Mfg. Co.
Whitney Electrical Instrument Co.

Insulators and Insulating Material.
Central Electric Co.
Empire China Works.
Kartavert Mfg. Co.
Standard Paint Co.
Standard Underground Cable Co.
Sterling Supply & Mfg. Co.

Junction Boxes.
Bossert Electric Construction Co.
General Incandescent Arc Light Co.
Ward Leonard Electric Co.

Lamps, Arc.
Central Electric Co.
Diehl Mfg. Co.
General Electric Co.
General Incandescent Arc Light Co.
Standard Thermometer & Electric Co.
Western Electric Co.
Westinghouse Electric & Mfg. Co.

Lamps, Decorative.
Central Electric Co.
General Incandescent Arc Light Co.

Lamps, Incandescent.
American Endoscopic Co.
Buckeye Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Hardy Lamp Works.
New York & Ohio Co.
Ohio Electric Works.
Sawyer-Man Electric Co.
Shelby Electric Co.
Sperry, B. N.
Westinghouse Electric & Mfg. Co.

Lightning Arresters.
General Electric Co.
McIntosh, Jas. D.
Westinghouse Electric & Mfg. Co.

Machine Tools.
Garvin Machine Co.

Mast-Arms.
Brady, T. H.
Meserve, F. W.

Meters.
Fort Wayne Electric Works.
Siemens & Halske Electric Co.

Mica.
Munsell, Eugene.

Name-Plates.
Becker-Name Plate Co.

Paint.
Standard Paint Co.

Patent Solicitors.
Duvall, Edw. S.
Thornberry, Henry S.

Platinum.
Baker & Co.

Poles, Brackets, Pins, Etc.
Central Electric Co.
Central Mfg. Co.

Porcelain Manufacturers.
Empire China Works.

Rail Bonds.
Forest City Electric Co.
Morris Electric Co.
Roebling's Sons Co., John A.

Railway Specialties (Electric).
Central Electric Co.
Electric Appliance Company.
General Electric Co.
Novelty Electric Co.
Sterling Supply and Mfg. Co.
Western Electric Co.
Westinghouse Elec. and Mfg. Co.

Reflectors.
Frink, I. P.
Wheeler Reflector Co.

Rheostats.
Cutler-Hammer Mfg. Co.
General Incandescent Arc Light Co.
Ohio Electric Specialty Mfg. Co.
Ward Leonard Electric Co.

Schools.
American School of Correspondence.
Electrical Engineer Institute of Correspondence Instruction.
International Corresp. Schools
United Correspondence Schools.

Soldering Sticks.
Allen & Co., L. B.

Specialties.
G. & E. Electric Co.
General Incandescent Arc Light Co.
Ohio Electric Works.

Steel Spring Wire.
Boker & Co., Hermann.
Cary Spring Works
Manross, F. A.

Storage Batteries.
American Battery Co.
Electric Storage Battery Co.

Switchboards.
Bossert Electric Construction Co.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.
Large & Co.
Western Electric Co.

Switches, Etc.
Central Electric Co.
General Electric Co.
General Incandescent Arc Light Co.

Switches, Etc.
Hart & Hegeman Mfg. Co.
Hart Mfg. Co.
Jones & Son, J.
Paiste Co., H. T.

Telephones.
American Bell Telephone Co.
American Elec. Telephone Co.
Bunnell & Co., J. H.
Central Electric Co.
Central Telephone & Electric Co.
Connecticut Telephone & Electric Co.
Eureka Electric Co.
Farr Telephone & Construction Supply Co.
Gordon, A. Y.
Mianus Electric Co.
National Automatic Telephone Co.
New York Telephone Co.
North Electric Co.
Ohio Electric Works.
Reliable Electric Mfg. Co.
Sterling Electric Co.
Stromberg-Carlson Telegraph Mfg. Co
Taber & Mayer.
Telephone Mfg. Co.
Viaduct Mfg. Co.
Western Electric Co.
Western Telephone Construction Co.
Williams-Abbott Electric Co.

Tools.
Garvin Machine Co.

Transformers.
Fort Wayne Electric Works.
New York & Ohio Co.
Westinghouse Electric & Mfg. Co.

Turbine Governors.
Lombard Water-Wheel Gov. Co.

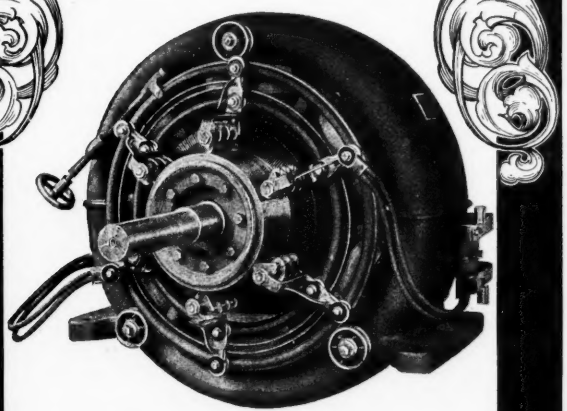
Voltage Regulators.
Belknap Motor Co.

Water-Wheels.
Leffel & Co., Jas.

Wires and Cables.
American Electrical Works.
Central Electric Co.
Crefeld Electrical Works.
Eastern Electric Cable Co.
Electric Appliance Company.
General Electric Co.
India Rubber & Gutta Percha Insulating Co.
Montauk Multiphase Cable Co.
National Conduit & Cable Co.
National India Rubber Co.
New York Insulated Wire Co.
Novelty Electric Co.
Okonite Co., The.
Phillips Insulated Wire Co.
Roebling's Sons Co., John A.
Safety Insulated Wire & Cable Co.
Simplex Electrical Co.
Standard Underground Cable Co.
Western Electric Co.

X-Ray Apparatus.
Ritchie & Sons.

BULLOCK ENGINE TYPE GENERATORS



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CINCINNATI, O.

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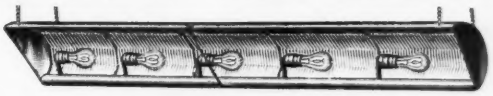

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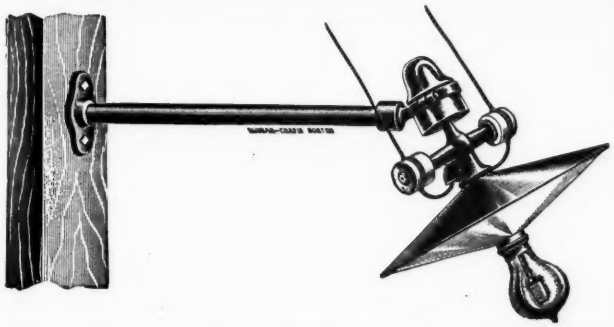

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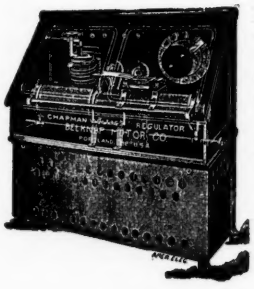

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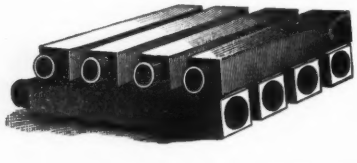

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